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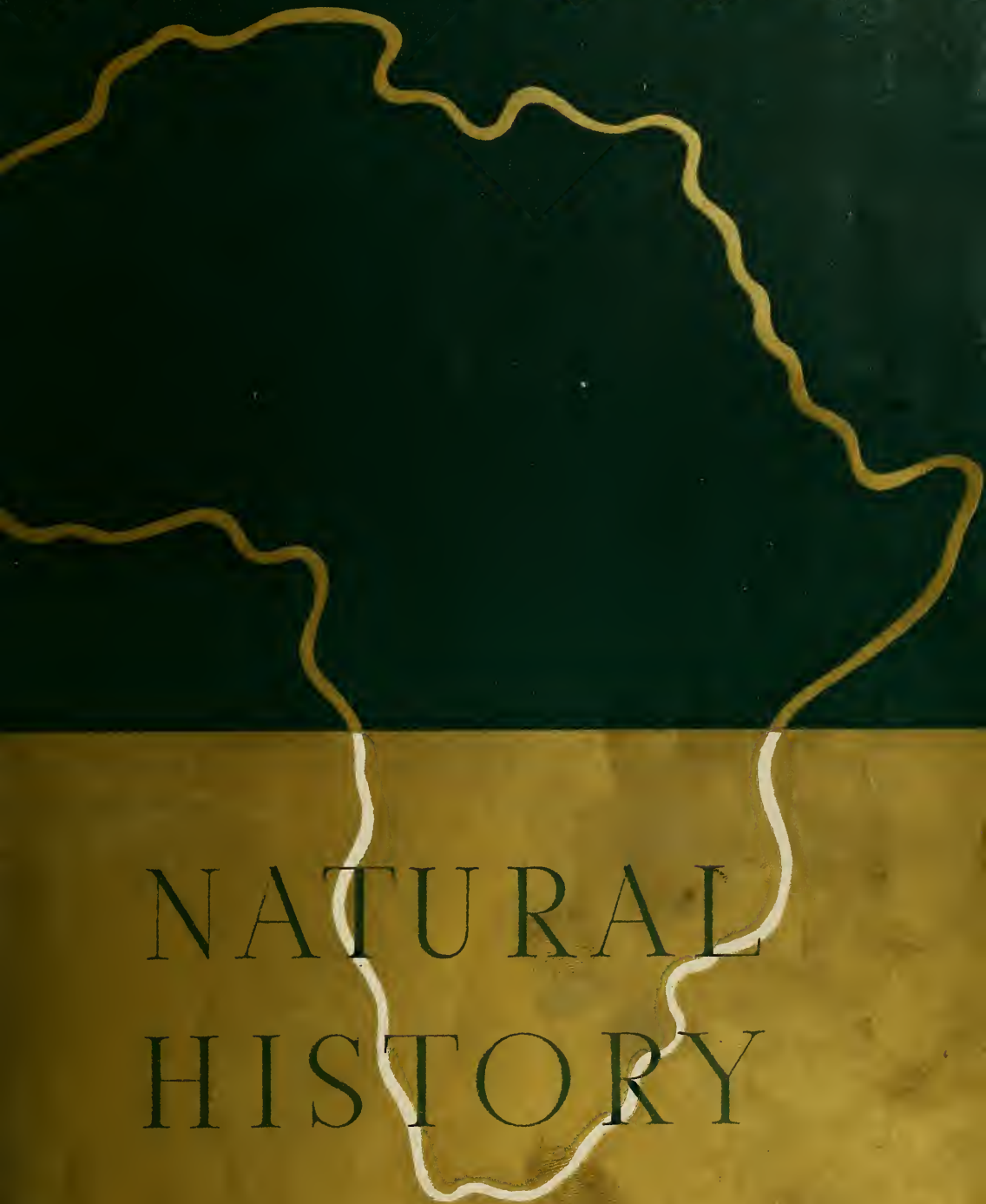
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JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

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JANUARY 1936



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No. 2 represents the Bengal Tiger [*Felis tigris*] in the Kheri forest in India. The tigress leads her cubs to the stream to drink and through the reeds and trees appears the lordly male. This represents one of the groups collected for the American Museum by the Vernay-Faunthorpe Expedition.

No. 3 is the Gorilla [*Gorilla savages*]. Here we see the Lake Kivu region of the Belgian Congo with the slope of Mt. Mikena showing in the purple sunset. This great animal was carefully studied by Carl E. Ackley on his many trips to Africa and from this theatre one will glean many interesting facts about a creature that has long been too little known.

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NATURAL HISTORY

The Journal of the American Museum of Natural History

VOLUME XXXVII



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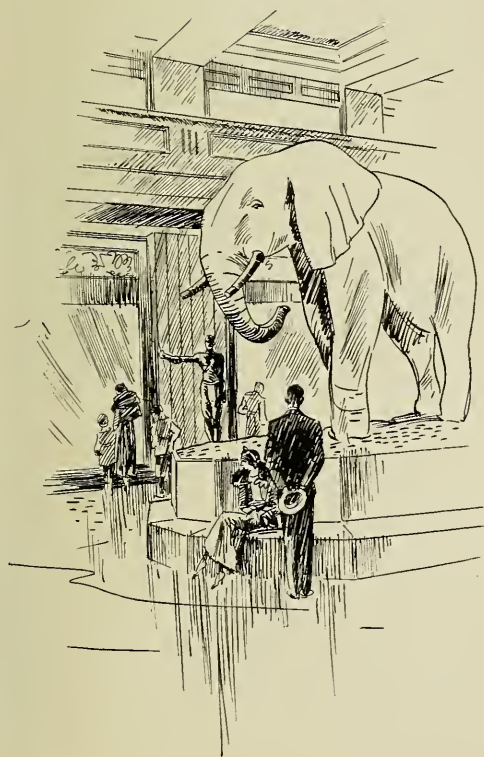
Glimpses Into



The new Akeley Hall of African Mammals opens to public view early in 1936, after years of planning and preparation, although some of the exhibits are still to be provided

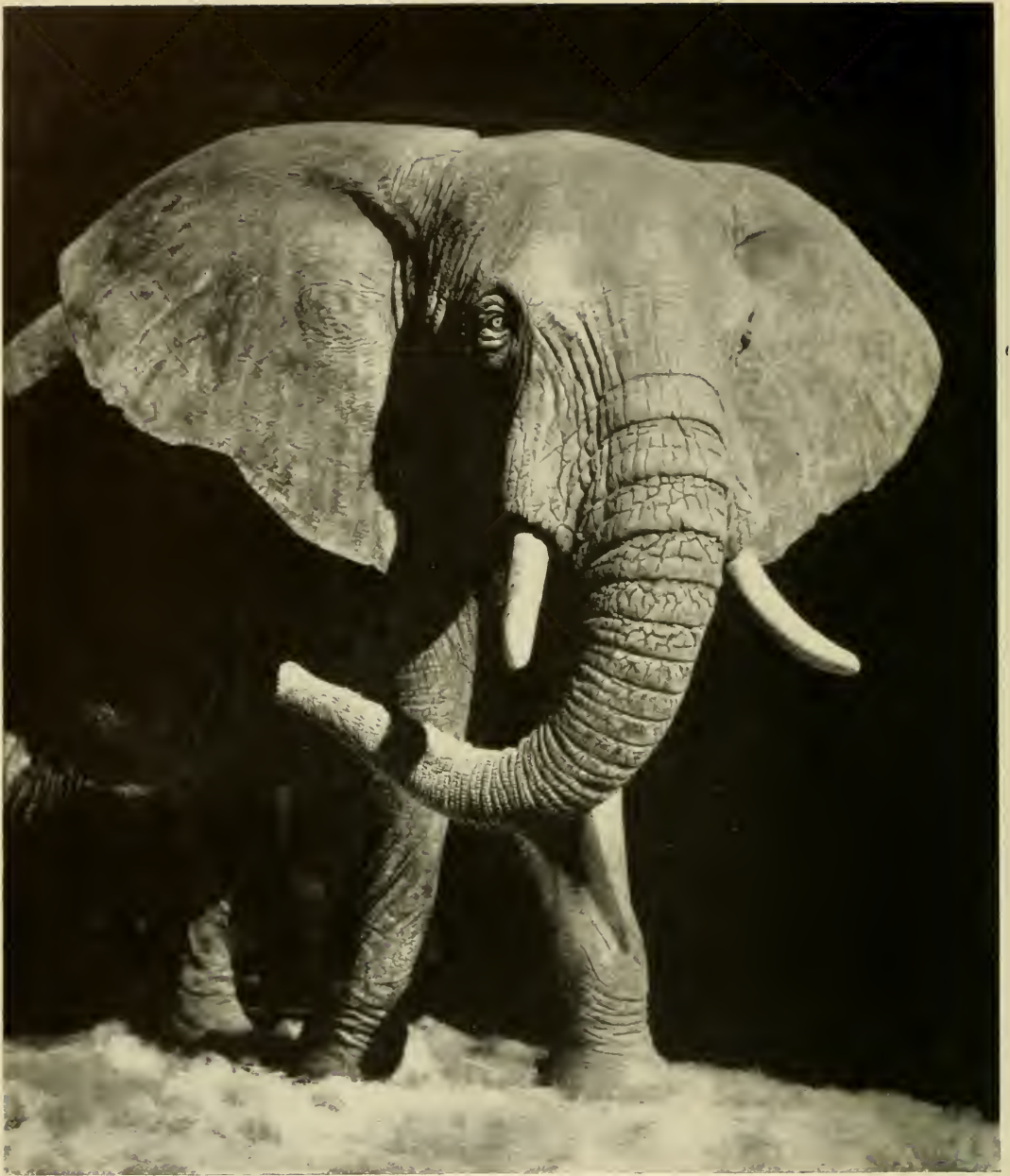


Akeley African Hall



Here are parts of the real Africa recreated in the American Museum as Carl Akeley dreamed. This has been made possible through the generosity of friends, and accomplished by the skill, artistry, and infinite labor of a large staff of workers in the Department of Arts, Preparation, and Installation.

Above is a silhouette of the "Elephant Herd" that dominates the hall, an exhibit unique in museum annals. The three drawings are by Frank Swain



Photograph by Wurts Bros.

THE REAR GUARD

In every herd of elephants at least one animal takes the responsibility of wheeling about at frequent intervals to see that all is well behind. The young male shown above is mounted in this position in the elephant herd which forms the central exhibit in the Akeley Memorial African Hall at the American Museum. It

was collected by John T. McCutcheon in 1910, when he was in the field with Carl Akeley. It was during this expedition that the idea of a great African Hall first germinated in Akeley's mind.

"The Rear Guard" was prepared and mounted by Akeley

Akeley's Dream Comes True

The Akeley Memorial African Hall—a monument to the world's greatest wonderland of wild life

By DANIEL E. POMEROY

AKELEY loved Africa. He knew the primitive Africa, and he saw it being destroyed. It thus became the single purpose of his life to preserve and portray Africa for posterity. He dedicated his life to the task of bringing Africa to America.

Those of us who knew Akeley in the latter years of his life remember chiefly his mounting zeal in the approaching realization of his great dream. He was a man of tremendous nervous energy and with a single tremendous purpose. You had only to see the set of his lean jaw and the fire of inspiration in his eyes to know this.

Though slight in stature, he was wiry and strong, the slight stoop of his shoulders merely increasing the impression of latent vigor. Whether he was in his studio working out some new trick in the displaying of animals or following a jungle trail in quest of specimens, you felt the constant power of his great vision. Yet there was nothing grim about his personality. He had a ready sense of humor and was mellow with kindness and fine sentiment.

His enthusiasm often resembled that of a youngster on vacation, and because of this youthful zest it was easy to visualize his early struggles.

Early ambitions

In the strictest sense of the term, Akeley was a self-made man. As he used to put it, by all the rules of the game he should have been a farmer. But he was always more interested in birds and chipmunks than in crops and

cattle. And he was only sixteen years of age when he announced his life work by having business cards printed stating that he did "artistic taxidermy in all its branches." The portent of this pronouncement lies in the fact that at that time the mounting of animals was in no sense an artistic craft. Akeley saw the possibility of raising taxidermy to an art.

"Stuffing" versus art

Taxidermy before Akeley was scarcely more than a variety of upholstery. The expression "the stuffing of animals" was literally applicable, for the procedure was simply to turn the animal upside down and stuff it with straw, rags, paper, or other rubbish, and to distort the features into as ferocious an expression as possible. Lacking an adequate framework upon which the configuration of the body could be moulded, the specimen frequently bulged or shrank out of all harmony with its original anatomy. Then it would be stood up by itself in a case, without any background. The result was something far removed from nature.

All this offended Akeley's sensitive artistic conscience, even at an early age. Then followed his long years of pioneer work. Gradually he evolved the technique, described elsewhere in this issue of *NATURAL HISTORY*, which has been adopted by museums throughout the world.

In the end, Akeley won renown as a sculptor, an inventor, a naturalist, and an explorer. But these achievements were incidental to his enduring passion for artistic taxidermy and his ultimate purpose through it to create an African Hall.

The first definite seeds of Akeley's dream were planted when he went to Africa for the first time, in 1896.

Akeley's vision

A unique mental and artistic outlook gave a distinctive quality to his impressions. He had long since passed his apprenticeship in the workshops of Ward's Natural Science Establishment, and had devoted eight years in Milwaukee to the development of his own methods. Therefore, when he went to Somaliland with Prof. Daniel G. Elliot, a new world was opened up to him. This taste of the world's greatest wonderland of wild life created visions of unimagined possibilities for his artistry. He saw Africa's magnificent animal forms not as many others have as potential trophies, but as things of beauty to be preserved. Africa would be his vast studio. This awakening came to him almost forty years ago.

"I was so bewitched by the beauty and splendor of Africa," he wrote, "that it seemed to me inconceivable that I would not immediately return."

But nine years were to pass before he was able to go back. It was chiefly in this interval that he perfected the details of his display methods, which were to make possible his dream.

The result of his 1905 expedition was the elephant group, "The Fighting Bulls," in the entrance hall of the Field Museum.

He then wished to elaborate upon his studies on the elephant, which he had found to be the most fascinating of all wild animals, and to create a larger exhibit, requiring a spacious and impressive setting. The proposal he made to the American Museum of Natural History to collect a group was accepted, and in 1909 he again took up the trail, this time on the slopes of Mount Kenya and in Uganda.

A statuesque group of four elephants was planned as the central figure for African Hall. And immediately upon his return he set about mounting them. Subsequent expansion of the plans, however, increased the group to eight animals.

It was on this 1909 expedition that an old bull elephant, tired of being hunted by him, rudely interrupted his activities, as he put it, by using him as a prayer rug. The encounter nearly cost Akeley his life.

Anyone who knows how vigilant Carl Akeley was on the trail will take this incident

as a warning that an emergency can arise in Africa against which the most skillful hunter is well-nigh helpless. When Carl suddenly became aware that the elephant was almost on top of him, he snatched up his gun and of course tried to shove the safety catch forward. It would not budge. He knew he must shoot instantly, and it is a measure of his desperation that he determined to pull the trigger hard enough to fire the gun no matter whether the safety had jammed or not—an altogether impossible feat. Then something happened which dazed him.

Without knowing whether he had shot or not, he suddenly felt a tusk right at his chest.

What he did next was the result of having mentally rehearsed such an emergency many times on the trail. He grabbed the tusk with his left hand, took hold of the other with his right and, swinging in between them, went to the ground on his back.

The elephant drove his tusks into the earth, his curled-up trunk against Akeley's chest. Akeley felt himself being crushed, then lost consciousness. The thing that stunned him was a blow from the elephant's trunk, which broke his nose and tore his cheek open to the teeth. But some obstruction in the soil which the tusks encountered saved Akeley from being crushed to death. The beast left him to charge the terrified native boys, who were his only companions at the time, and then escaped.

A return to life

Akeley lay unconscious for four or five hours. Believing him dead, the natives, in their superstition would not touch him. When consciousness returned to him, although he felt no pain, he could move neither his arms nor his legs, and concluded that his back was broken.

His back was not broken, but his chest had been badly damaged and several of his ribs had penetrated his lungs. He was in bed for three months.

Akeley always said, with his characteristic philosophy, that his invalidism was not a complete loss, for it gave him time to think out his great dream. However, it is likely that those injuries turned the tide against him in 1926 when fatal illness terminated his life, just at the eve of the realization of his dream.

The plan for an African Hall was well

crystallized in his mind when he returned to America in 1911.

On this expedition Akeley had discovered a serious handicap to his work. For the life-like re-creation of wild animals in museum displays, as well as for the study of their habits and actions under various circumstances, motion pictures were an essential adjunct. But no camera had been devised which was fast enough to enable a rough and ready naturalist to record rapidly moving events which were happening unexpectedly in different quarters. Akeley wanted a motion picture camera that you could aim about like a pistol. And so necessary was it to his work that he resolved not to return to Africa until he had produced one.

Engineers and mechanics at first declared Akeley's schemes for his camera to be wild dreams, impractical, impossible ideas of an untrained mind. But after long experimentation he completed a model, which bore no likeness to the conventional apparatus. To those familiar with the old types of camera, the Akeley resembled a machine-gun quite as much as it did a camera. Indeed, it is alleged that when a young lieutenant in the World War was setting up the machine, he was suddenly confronted by seven Germans, who mistook his formidable film apparatus for a new type of Yankee machine gun and threw up their hands in surrender.

Akeley's camera has been used on practically every exploration of consequence and also plays an important part in the production of news reels and in Hollywood. But Akeley had no thought of the commercial value of his invention. He devised it specifically for his task of bringing Africa to America.

The Akeley cement gun

Another invention which he hit upon in his studio work and which found practical applications in industry, was his cement gun. This is a device which enables one to spray liquid cement upon a vertical or inclined surface. Akeley first devised it for the purpose of modeling the manikins which serve as the foundation upon which the skins are mounted. Today the cement gun has a large and important commercial utility in various types of construction. During the war it was valuable in the building of concrete ships.

The World War interrupted Akeley's African program by diverting his abilities to technical problems in the service of the Government, and it was not until 1921 that he was able to return to Africa.

Collecting gorilla

The specific purpose in this expedition into the gorilla country was to collect scientific information about the most important yet least known of the manlike apes and to secure material for a group of these creatures for the Hall. The trip was made with Mr. and Mrs. H. E. Bradley. The locality in which the program of work was carried out was the mountain paradise of Kivu, which Akeley always said was the most beautiful spot in all the world. His favorite scene is reproduced in African Hall as the setting for the superb Gorilla Group. No one can challenge Akeley's opinion of its surpassing beauty or fail to appreciate the rapture he felt as a nature lover exploring in the mountains of Kivu.

Knowing his love of this section, there is additional meaning to us in the fact that it was precisely here that he passed away a few years later at the very peak of his career.

The last five years of Akeley's life were marked by rapid progress toward the creation of African Hall. Yet there were repeated discouragements, which continually threatened to frustrate him.

The creation of the Hall depended upon the achievement of three things. Of these the first, the development of the art of displaying animals in their true settings, had by now been accomplished. The second essential step was to train a body of specialists who could carry out the various processes: collectors, photographers, artists, taxidermists, anatomists, etc. Akeley spent years in developing the talents of men who were to assist him. Louis Jonas, who worked with him during these years has repeatedly spoken to me of Akeley's peculiar faculty for selecting just the man who was fitted for a particular job by ability and temperament.

"Mr. Akeley has a constant supply of surprising ideas," I remember his telling me in his enthusiasm. "His ingenious way of facing each problem as it comes along and working it out, is amazing. One minute you will think he has encountered the impossible obstacle; then

a light comes into his eye and you know that he has changed failure into success."

His personality captivated Jonas, just as it did everybody else, from the moment he met him. The old khaki trousers he wore and the corn-cob pipe he smoked in his studio might have detracted from the bearing of anyone less of a true artist, but we all remember them as part of his beloved personality.

As Jonas has frequently impressed upon me, the encouragement and inspiration that Akeley gave to the rising naturalists of his day was one of his most valuable gifts, and will bring profound consequences for many years to come.

The third essential part in Akeley's plan was the task of convincing the patrons of natural history that his conception was worthy of their support. He had to show them that African Hall, a monument to the passing wild life of Africa, was as truly worthy of their support as any project in marble or on canvas.

A benefactor

This brings us to 1925, for it was then that the great opportunity came to Carl through his acquaintance with George Eastman, of the Kodak Company.

I first knew Eastman through business connections, but it was our mutual interest in the outdoors that drew us together. Eastman enjoyed camping and had made a number of trips into northwestern Canada, Alaska, and elsewhere. He had been interested in my trip to the Sudan in 1914, but the first evidence that his mind was seriously turning toward Africa came one day in the autumn of 1925 when he called me by telephone from Rochester and said: "When are you going to Africa?"

I thought he was joshing. "Any time you say," I answered.

"The best I can do," he said, "is a year from this December."

That was a long time ahead, but I went to Rochester to see Eastman right away. I saw that there was a great opportunity to make an expedition that would count for something in science. I was then a member of the American Museum of Natural History and knew of Carl Akeley's scheme. When I explained it to Eastman, I found him keen as a briar, and he authorized me to get in touch with Akeley.

Akeley always came straight to the point. "If Mr. Eastman is interested in African Hall, I am interested," he said. "If not, I'm not."

I asked Carl what he proposed Mr. Eastman should do.

"You know what my plan involves," he said. "I'd like to see Mr. Eastman give a million dollars."

That was beyond the bounds of possibility and I endeavored to tone Carl down.

"All right," he said. "But let's go right up to see him."

We took the night train.

Carl had been impeded so long by lack of funds that he scarcely dared believe anything would come of this. All that evening in the smoking car he was as excited as a man waiting to hear the verdict of a jury, for African Hall had grown as important to him as life itself. He would remain nervously silent for a long time, puffing on his old corn-cob, and then blurt out: "By heaven, Dan! If Mr. Eastman only can see how important—how necessary this is" Then he would break off. He wouldn't let himself build a great air castle.

But even though I warned him against killing the goose that laid the golden egg, he could not refrain from aiming at a high figure.

George Eastman was then seventy-one years old. He was a heavy man with an unusually pleasant face and a fine, clear complexion. He was modest to the point of shyness.

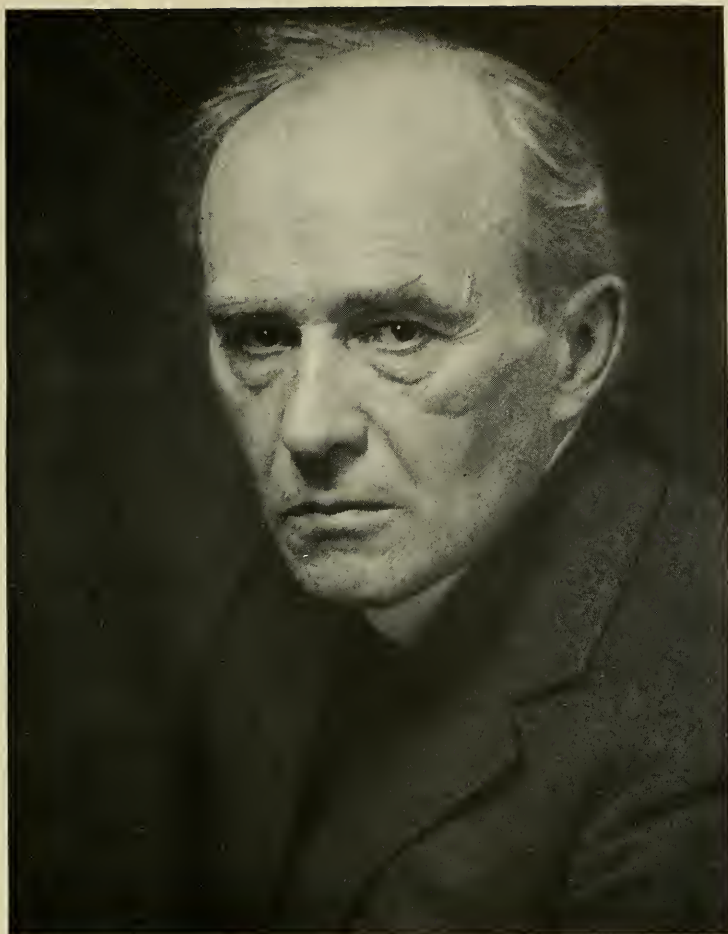
When we talked with him the next day, Akeley painted a word picture of the proposed African Hall, explained that there was no money, and told Eastman that the opportunity was his to create the greatest exhibit in the world. He then asked him point blank for a million dollars.

Eastman said that he could not do that, but that he would give \$100,000 to start the thing.

Carl and I had worked out a budget in which the cost of preparing each regular group would be \$25,000 exclusive of the expense of securing the specimens and accessories, and the cost of the larger corner groups would be \$50,000.

Eastman agreed to stand his share of the expense of an expedition, and his \$100,000 would represent three groups—the water hole group, the buffalo group, and the klipspringer.

I told Eastman how generous and thoughtful he was, and agreed to collect and contribute another group myself, the greater koodoo. I said also that my friend Daniel B. Wentz, of Philadelphia, might make a similar con-



A photograph of Carl E. Akeley taken in 1920 by J. H. McKinley

tribution, which he shortly afterward did. We palavered far into the night over itineraries and preparations.

Carl was jubilant. It was the first real break he had had. When we were alone he said:

"Dan, this is the most wonderful thing that has ever happened. At last I begin to see the realization of my life dream. At last!"

We were all, of course, tremendously excited. The expedition which grew out of that meeting was the Eastman-Pomeroy-Akeley Expedition of 1926-1927.

With an encouraging portion of the African exhibits provided for, Carl threw himself with renewed vigor into the task of completing the plan of the Hall. Having pondered over the lay-out for so many years, he visualized every detail. When we departed for Africa he had the whole scheme worked out.

A sad event occurred a month before we sailed. Daniel Wentz, who had agreed to pro-

vide the lesser koodoo group, passed away. We carried out his intentions, and the group stands as a memorial to him.

One of the final worries that beset Carl was the rapid extermination of certain of the animals he sought. As Henry Fairfield Osborn had expressed it:

"We palæontologists alone realize that in Africa the remnants of all the royal families of the Age of Mammals are making their last stand, that their backs are up against the pitiless wall of what we call civilization."

The quagga had vanished and numerous other forms were on the verge of extinction. Carl realized that in twenty-five years the development of African Hall would be impossible, for the proper specimens would not be available.

On this expedition in 1926 the recent depletion of the wild life was continually borne in upon us. During a two-day trip down the Tana

River, Carl was dismayed to see how different it was from in 1912, when the region was swarming with game. It was now a complete waste.

Having failed to secure any specimens here, Carl wrote to Doctor Sherwood:

"I have not appreciated the absolute necessity of carrying on at the African Hall, if it is ever to be done, as I now do after this painful revelation. *The old conditions, the story of which we want to tell, are now gone, and in another decade the men who knew them will all be gone.*"

Today this crucial situation continues to threaten the success of the remaining groups, and impels us to hasten the gigantic project to as speedy a conclusion as possible. Altogether the Eastman-Pomeroy-Akeley Expedition secured material for ten groups instead of only six as had been planned. And other sponsors have led expeditions and generously provided funds for the preparational work. But we are still confronted with the urgent necessity of securing the support of others who are interested in the world's greatest wonderland of wild life and in this monument to it.

It was this fear of failing irredeemably to secure specimens of the vanishing Africa that drove Carl to such tremendous exertions in 1926.

In the midst of our intensive work in Western Tanganyika he suffered an attack of fever. This prevented him from accompanying me on the quest for the greater koodoo, and he was sorely disappointed. But it was essential that he be taken to the Kenya Nursing Home in Nairobi. In parting, I implored him to guard well his health in convalescence: "Your one aim must be to recover completely. Never mind the time it takes."

I later wired him to have patience, as my own return to America would be indefinitely postponed until we could complete our program of work.

But Akeley was a difficult patient. The King of the Belgians had been eager to send the local Belgian representative, Doctor Dersheid, with Akeley on a survey to establish a game sanctuary in the upper Congo, and Akeley was impatient to get started. On October 14, before he had recovered his strength, the party, including Mrs. Akeley, two members of the Museum staff, and Doctor Dersheid set out. The trip was strenuous.

On November 1 there were many hills to

climb, and the heat and humidity were almost unbearable. Akeley became faint and ill and too weak to walk. He was carried on an improvised hammock about four miles, when a thunderstorm broke and it was necessary to make a temporary camp. The next day Akeley felt better and was able to walk into Rutshuru. Akeley was approaching the country which he loved more than any other in the world, and he seemed to be torn between the desire to rest and the great urge to reach the goal.

After about a week the safari proceeded through cold, wet weather to the Rueru camp. Akeley felt very weak, and passed the thirtieth in bed, reading and sleeping.

We have no way of knowing whether he had any awareness of the end. The end came suddenly on November 17, after two and one-half days of exhaustion following the arrival at Camp Mikenno.

Akeley often had said he wished "to die in the harness," and "to be buried in Africa." He died in the country he loved, and was buried in a tomb of solid volcanic rock on the slopes of Mount Mikenno. In Akeley African Hall you can see this mountain in all its beauty in the background of the Gorilla Group.

It is the sharpest sort of tragedy that Akeley should have been taken just at the peak of his great dream. But there is mitigation in the fact that he knew that the great project to which he had devoted his life was to be carried out.

The group of specialists whom Akeley had trained and who had served him in the field—Harry Rockwell, Raddatz, Leigh, Jansson, and others—would carry on the banner, under the guidance of Dr. James Clark, whose long association with Akeley makes him such an expert director of the project.

The work of the expedition on which Akeley died was ample proof of the practicability and extreme importance of his great plan. Action by the Board of Trustees of the Museum came as a direct result of it, and the construction of the African Building was authorized. Soon afterwards it was decided that the building should be a memorial to Akeley.

Akeley bequeathed to posterity a noble gift, the beauty of original Africa, preserved for generations to come. Akeley African Hall is a monument to the royal families of the animal kingdom, and is the symbol of his genius as the father of modern museum display methods.

The Mountain Gorilla Group

IN the following four pages are shown views of the Gorilla Group in the Akeley Hall of African Mammals, which has particular significance because it displays a species in which the late Carl Akeley was most interested. He was engaged upon an expedition to the very locality shown in the group when his work for the Hall of African Mammals was so abruptly terminated by his death. The group pictures a vista of the Kivu volcanoes from the side of one of them.

Shown in this group is *Gorilla gorilla*, the mountain gorilla, subspecies *beringei*, a race confined to the eastern part of the Belgian Congo in Central Africa. Here it occurs from the upper end of Lake Tanganyika northward to Lake Edward, along forested slopes, and eastward to include the Kivu volcanoes. The mountain gorilla is distinguished from its lowland relative, the West Coast gorilla, principally by cranial characters, thicker and darker pelage, and a slight difference in the proportion of shorter arms and longer legs. It is also stated that the two types of gorillas have different habits, that the mountain animal climbs trees less frequently and is more terrestrial.

In the popular mind the life history of the gorilla is commonly associated with the accounts of the early African explorers, Du Chaillu, for example. The gorilla is portrayed as a savage animal ready to charge the hunter

on slight provocation. He beats his breast with resounding blows, rushes upon the man who would molest the gorilla family, tears the gun from his hands and bends it into bowknots, and then tears the hunter limb from limb. The observations of Carl Akeley did much to dispel illusions of this sort, and after him a number of other naturalists studied, photographed, and lived with the gorilla to the end that a much better understanding is now possible.

The full-grown gorilla is a powerful animal fully capable of many of the feats of strength ascribed to him, and he is dangerous if crowded too far. Under normal conditions the gorilla is not aggressive and tolerates considerable interference before displaying the danger signs of an active resentment. Usually these animals are shy and flee as soon as they are aware of the presence of man. When pursued, the old male may drop behind and stage a demonstration of rage which is pure bluff. Because of the potential danger of coming to close quarters with an angry male gorilla, the bluff is apt to be quite effective. Under these conditions, the gorilla often uses the thick cover and seems reluctant to face man in the open.

Gorillas are social in habit and the customary group is a family or clan composed of one old male, who dominates the band, and several females, subadult males and youngsters. They are vegetarian in diet and roam through the







GIFT OF MESSRS. JULIUS F. STONE, GEORGE A. STONE, AND FRANZ T. STONE; MISSES EDNA A. STONE, THEODORA M. STONE, AND NATALIA S. STONE.

ANIMALS by *Carl E. Akeley.*

BACKGROUND by *Wm. R. Leigh.*

FLORA AND FOREGROUND by *Albert E. Butler, assisted by U. Narahara, George E. Petersen, George F. Mason, Joseph M. Guerry; Mrs. Mary L. Jobe Akeley, collaborator.*

DIRECTION, *James L. Clark.*

SCIENTIFIC DIRECTION, *H. E. Anthony.*



heavy forest growth where they find abundant plant life to their liking. One of their favorite food plants is the so-called "wild celery" shown in the foreground of the group. They are not active at night but sleep where night finds them, making nests or shelters on the ground or climbing up into the lower limbs of trees.

It is not likely that gorillas fear any enemy other than man and the leopard. The leopard would hesitate to attack a full-grown gorilla, but would have no difficulty in overpowering a young animal separated from its companions. Fortunately, the gorilla, both mountain and lowland races, is protected by law throughout its entire range, and in the Parc National Albert the mountain gorilla enjoys complete sanctuary.—H. E. ANTHONY





THE LEADER OF THE LION GROUP

This handsome specimen of an adult male lion was the result of great perseverance on the part of the Carlisle-Clark Expedition. Although two males had already been obtained, the party remained in the field an extra week

after all other work was completed until an exceptionally fine animal, such as this one, could be collected.

Large, male lions with good manes are rarely seen in East Africa.

The Lion Group and Its Creation

The beauty of African wild animal life captured and preserved in an American Museum exhibit

By G. LISTER CARLISLE, JR.

MUSEUM expeditions are apt to come into being as the result of the fortuitous meeting of men who have made some branch of natural history their life work and amateurs in natural history. Their interests and activities have made careful observation in the wilds second nature to both and, also, one of the pleasures of living. The Carlisle-Clark African Expedition started in this way from a meeting with Carl Akeley in the American Museum shortly before he left for Africa and his beloved gorilla sanctuary, where he died.

At this meeting it was evident that we held similar views on the high value of museum natural history exhibits in the cause of conservation, or appreciation of wild life and interest in its preservation. Later came happy meetings with Professor Osborn and a fuller knowledge of the needs of the American Museum and of the ambitious plans for the Akeley African Hall which is intended to bring something of great Africa, and its interest, to New York.

A plan materializes

The plans at once appealed to Mrs. Carlisle and to me. We had been in the English Sudan during the previous year and were anxious to return to Africa to experience again the thrill of living in unspoiled country. Thus the expedition which has resulted in the Lion Group was launched. This love of the world as it was in the beginning is deeply ingrained in many of us, and those who have experienced years of life in some one of the few untouched areas count the memory as very precious. There comes as a natural sequence the wish to aid in

one of the most important causes of our times, that of the preservation of nature's interest for future generations.

A "conservation" expedition

When the expedition first took form in our minds, much thought was given to the question of whether killing and conserving could be made logically to mix and it was decided that our expedition should be run on a non-killing basis in so far as it was possible and, at the same time, meet the Museum's requirements for group material.

This plan was carried out, and none of us did any unnecessary killing. In fact, Mrs. Carlisle and I did no killing at all.

The outfitting of an expedition is a special field wherein only experience is of value, and we were fortunate in that much of this sort of experience centers in the American Museum. The many expeditions sent out in the past have reduced the problem of outfitting to an exact procedure based on accumulated knowledge—and this knowledge is not one of the least assets of the Museum. My associate in the expedition, Mr. James L. Clark, assistant director of the Museum, carried most of this load and later in Africa gave a lesson in efficient field work which those who accompany him on other expeditions will likewise experience.

Our strong desire was that the Lion Group should embody all excellence that art and craft could give, and, now that the group is completed, we feel our objective has been attained.

By various ways we all reached Nairobi and there met our white hunter or guide, Al Klein, who had been in Africa for twenty years. Klein has been, literally, "in at the death" of no less

than a thousand lions, but this is not to infer that Klein, personally, shot that number. As a matter of fact he is opposed to unnecessary killing. Al is not very large physically, and, when we first met, I wondered how all of those lions could have missed him. Later I understood. No lion has yet been quick enough to get to him first, and his deep, commanding voice is a defense in itself. Al is a very delightful companion indeed, witty, and a collector. As a boy, brought up at Haverstraw on the Hudson, he collected birds' eggs. Later his search for bigger and better eggs led him to the dry wastes of southern Africa where a boom in ostrich farming provided a profitable market for the wild ostrich eggs. From there he worked his way to East Africa where with the passing of the years, he has founded a particularly happy home, has become one of the noted East African guides, and he is certainly a raconteur of parts.

Two weeks of hard work awaited us at Nairobi before the equipment was thoroughly gone over and packed in five light motor trucks under a system that permitted of access to at least a part of our equipment without disarranging all of the rest. These were fascinating weeks as the East African plateau has a good climate, and a future, and in consequence has drawn to it many ambitious English who are rapidly building a white man's country astride of the Equator. The natives, instead of being pushed back as the land is occupied, are given large native reserves wherein they live peacefully and without fear of attack from the predatory Masai. The treatment of the natives in East Africa and in the Sudan is wise, just, and definite, and well may England be proud of her Oxford and Cambridge administrators.

The "D.C.'s"

Meeting and knowing the English District Commissioners, or D.C.'s, as they are called in the Sudan and East Africa, is a major pleasure. Their lives are full of vivid experiences, many of which turn on personal courage and confidence in their own ability to settle tribal disputes fairly and quickly without resort to force. As a necessity they must know the native language, and the native customs which serve as native laws, and their aim is to render verdicts in their local courts in accordance with tribal ways. Strong attachment and loyalty generally characterize these natives in their

relations with their British leaders. England rules her East African Colonies with marked consideration for the happiness and material welfare of her native subjects. Many white colonists in Kenya even think that too much consideration is given them but, be that as it may, the result is that England is enabled to rule her East African Colonies with a mere handful of white troops. What the future may hold, however, is obscure, as the outcome of the present Abyssinian situation may profoundly influence English interests in East Africa and the Sudan, and there are even wider possibilities.

Game commissioners

The game commissioners of East Africa are splendid men, often retired army officers, and their control of hunting is very much more effective than any hunting control known to us in America. In East Africa the game laws are obeyed, or retribution is swift and adequate. On his return from safari many a hunter has been surprised at the "news value" given by the game commissioner to certain supposedly unknown incidents that occurred out in the Blue. There must be an "underground telegraph" or a "grapevine system" supplying red-hot information from the field, as the game commissioners know all that happens on an expedition, apparently, as soon as it happens.

The East African plateau is interesting country, with its several high dominating mountains, its hills and grassy plains, its Rift Valley and high escarpments. We crossed the Rift Valley soon after leaving Nairobi, and it is, perhaps, the most outstanding geological feature in Africa. Imagine, if you will, the Highland area of the Hudson without a river flowing in the trough and, after adding length, ten miles to the width, and two thousand feet to the height, the comparison will reasonably apply to the valley at the point where we crossed it. But the genesis of the two valleys is so different. The Hudson Valley was eroded by water, bit by bit, while the Rift Valley was formed by the subsidence of the block between two roughly parallel faults, and the amazing fact is that the Great Rift Valley systems extend from Northern Palestine to southern Africa and embrace several of the larger lakes such as the very deep Lake Tanganyika. Lake Baikal in Siberia is another long, deep lake, formed in this unusual manner. It was really thrilling even trying to understand the geology of the area as we

descended the steep eastern escarpment where, incidentally, grow the world's largest cedar trees. Game or no game, and there is generally some in sight, travel in East Africa is full of incident and food for thought.

We were traveling southerly from Nairobi in Kenya toward the plains area in Northern Tanganyika where there is the last great concentration of animal life likely to be found anywhere in the world. This was Carl Akeley's opinion, and the more I think of it, the happier I am that we did so little to disturb that wild animal zoo which, fortunately, has now been made into a closely guarded game refuge.

Reaching the lion country

Our guide, Al Klein, was heading for a little grassy swale on the side of a certain wooded hill overlooking the plains—now pictured as the background in the Lion Group—and he was quite keen about getting there privately. Al is noted for his good judgment in the selection of hunting country, but he does not believe in advertising. Our desire was to reach the site of the proposed base camp in such a manner as to prevent others from following our trail. This important maneuver added three days to our journey, but it was worth it!

We were then in real lion country—and alone—and thereafter we saw from two to twenty lions daily, some duplicates no doubt, as there was plenty of game in the area and no need for the lion to travel far in search of food.

As soon as our base camp was established in the center of the best lion country on earth, we began our inspection of the local lions and hunted tirelessly for individuals suitable for the proposed group. Our group was to be real in every way, an artistic and truthful reproduction of an East African scene, and the amount of work involved in the consummation of such a project is little realized by the casual visitor to the museum. Groups may be made from a hunter's imperfectly cured skins and his recollections of the surrounding country; but the Akeley Hall is different. Using the Lion Group as an illustration, we have there an exact and artistic reproduction of East African lions and of the hills and grassland where they live and hunt. At times single lions are encountered but generally more. In fact, on one occasion I saw sixteen together, but in this part of East Africa they usually live in small family groups similar

to the one represented in the Akeley Hall. The modeling is based on intensive study of the animal, on a scale model of the group made in the field (an unusual refinement), on detail measurements, and on plaster casts of the lions taken after the skins had been removed. Even the skeletons were preserved in order that they might be used in the modeling process in the American Museum.

Getting skins out of Africa in perfect condition for mounting requires knowledge and equipment and ours were delivered at the Museum in hermetically sealed poison-gas tanks in as perfect condition, I dare say, as any ever brought in. I am especially proud of this phase of the field work.

Successful lion groups are very difficult of accomplishment owing to the facility which the animal has of expressing his feelings and, after seeing my first hundred lions, I realized that the success of the group would depend on the ability of the sculptor. We have all seen poorly mounted lions in museums, but ours were to be different, and they are different—thanks to the ability of Mr. Clark.

The foreground of the group is as real as the animals, and most of the accessories in the group were actually brought from Africa. The fine background painted by Mr. W. R. Leigh is so true to the actual African scene which it reproduces that it refreshes my memory picture even to the small details. He made some twenty delightful oil paintings in Africa and from them the finished background was evolved. Few museum expeditions take artists into the field, and this is to be regretted, as their field "sketches" are necessary in the painting of a true reproduction of a wilderness scene.

Rich fields for the artist

Some expeditions to Africa have as their object hunting, others collecting, others photography, but few go to Africa merely to paint the vanishing wild-life in its native setting. This is rather strange when one considers how few good paintings exist of the old game herds once so numerous on our western plains. Today even the work of poor painters who lived in our early West is treasured in museums, while little effort is being made to preserve the present Africa game scene on canvas. Such pictures will be invaluable when time has destroyed the motion picture film. I can im-

agine nothing happier than a return to Africa with Mr. Leigh in order that he might make a series of game paintings; he is a talented animal painter as well as landscape artist. I am only sorry Mr. Leigh was unable to paint in that baboon fight we saw in the original setting. It was a family fight and noisy as usual, and there must have been forty in it.

Extra effort rewarded

The selection of the particular lions desired for the group was Mr. Clark's special province and he, therefore, did the collecting. The largest lion in the group is the young male behind the tree, and he was taken on the plea of some Masai tribesmen who reported that this particular lion had killed one of their steers during the previous night. The big-maned male was a find at the very end of our safari, when an extra week was allotted to an intensive search for a better specimen than we had so far collected.

Lions differ somewhat in characteristics as their habitats vary. From the Cornwallis Harris illustrations made before 1840 it would appear that the Cape lion, now extinct, grew a more luxuriant mane than the East African, and the Abyssinian lion, I believe, although smaller in body, also has a fine mane. The East African lion has a fair mane, and the group contains the best specimen encountered during three months in the field—with the possible exception of one that was too quick for us.

One cannot live in East Africa without acquiring a deep interest in the lion and his long rule over the country, and yet he lives dangerously. At times he is injured in killing; two of the lions we killed carried evidence of such injury and were not used in the group.

We came on one of these lions unexpectedly as he was lying by a water hole in a beautiful grove surrounded by a great troupe of barking zebras—all maligning him terribly. The zebras were making a wild woodland protest to the well understood determination of the lion to kill a zebra before he would permit the rest of the herd to touch a drop of the precious water. After enjoying the strange and noisy scene for a while, we decided that the lion was better than any we had, so he was shot, but it was afterward discovered that he was unable to make a kill owing to injuries and, in fact,

he was partly paralyzed in the rear. Presumably he had been injured in killing one of the larger animals able to put up some defense against his usually deadly method of attack.

If the quarry is small it may be struck down by a stroke of the lion's paw—and I have seen this done in the killing of a reed buck. However, where capture depends on the speed and weight of the lion, the animal attacked should have strength and size sufficient to hold up the lion long enough to break his fall. Zebras are often killed by lions, and the size and strength of the zebra, as well as his meat, may just meet the lion's requirements.

This September morning here in Connecticut I looked out of my breakfast-room window and saw seven wild deer. Two of these were undersized and in poor condition and I doubted whether they would get through the coming winter. In Africa it is different. There the lions and leopards pick off the laggards, the weak, and so aid in preserving the health of the herd. As I saw them on the Serrangetti plains they fairly radiated vitality, and few die of old age.

Those African evenings around a big fire, as notice to the lions as well as for warmth, were grand affairs. Delightful tales of Africa were continually punctuated with wild noises. The late afternoon peace of East Africa is made vocal by the cooing of the wild pigeon, but after his all pervading song has apparently lulled the wild things to sleep, then the killing begins. Later one listens to the grunts and deep-throated roar of the lion, to the curious cough of the leopard, perhaps prowling in the blackness just beyond the circle of light, and to the weird yell of the hyena—all telling of the content which follows the satiation of their wild hunger.

The venture proved absorbingly interesting. The carrying out of an American Museum Mission is a rare pleasure and, I may add, a privilege, and you, reader, may also desire to aid in this interesting work. There are still important groups to be procured for the Akeley Hall.

I would like to add that hunting and collecting are different, and it will be well to do one or the other, but not both. Also, it will be but fair for you to arrange for the completion of your work at the Museum, after you have had the fun of the field expedition.



(Above) A lion group in the making. The animals obtained in Africa being brought to an appearance of life in the preparation department of the American Museum. A picture of the finished group will be found on page 40.

(Below) A group of lions as they are most frequently seen in east Africa. They tend to group themselves into families except for the old males which usually roam about by themselves.



Photograph by
Martin Johnson



Mr. William H. Leigh at work in the field on color sketches to be used later for the background of the Lion Group. His gun-bearer,

and protector if necessary, is just behind him, but out of the picture. An artist cannot concentrate on his work and safety at the same time.



The Carlisle-Clark Expedition preparing to leave Nairobi. Systematic packing is very necessary as the unexpected generally happens during field work in Africa



Mr. Leigh at work on the lion group background in the African Hall at the American Museum. Few visitors, when viewing the fin-

ished work, will realize the amount of thought, effort, and skill that has gone into the making of the backgrounds



The end of three days' hard work. Some real road building was necessary when the heavily laden expedition auto trucks became stuck in a dried water-course



(Above) African travel made really interesting by an unexpected rain at the beginning of the dry season. This river was flooded to a disconcerting height, considering the fact that it was necessary for the expedition trucks to cross

through it en route to the Serengetti Plains. (Below) The Carlisle-Clark African Expedition returning to Nairobi after a three-month's collecting trip in the most interesting game country left to the modern world.



Some African Hall Chronicles

A saga of the collecting expeditions behind the groups

ALTHOUGH the visitor to the Akeley Hall of African Mammals may well be impressed with the meticulous artistry of the habitat groups, there is a story behind each group that represents as great a task as the making and assembling of the groups themselves.

These chronicles are the sagas of the expeditions that spent adventurous and arduous weeks in securing the fine specimens which represent African fauna and flora at its typical and best.

The foundation laid

The foundation for African Hall was actually laid when the Eastman-Pomeroy-Akeley Expedition set out for Africa. It was on this great safari, led by Carl Akeley himself, and supported most nobly by Messrs. Eastman and Pomeroy, that the main groups were obtained. The animals of the Plains Group and the great Water Hole Group were selected and hunted, as well as the greater and lesser koodoos, the klipspringer, the impressive buffalo, the wild dog, bongo, and impalla.

Much has been written on this famous expedition in the books of Mary Jobe Akeley, and the reader of this issue of NATURAL HISTORY will find it described in the articles of Daniel Pomeroy and Martin Johnson.

Mr. G. Lister Carlisle has also written for this issue a typical account of one of the African Hall expeditions so full of adventure and scientific interest. To avoid a natural repetition and to place before the reader in as concise form as possible the accounts of the several expeditions which contributed to this great monument to African wild life, the following excerpts from field records are given to show some of the dramas behind each group.

When the O'Donnell-Clark Expedition set out in January, 1931, to obtain the specimens of the giant eland of Southern Sudan, they realized that they were setting themselves a task similar to "looking for a needle in a haystack." Lesser eland were to be found over Southern Africa; but the giant eland, a great, shy, handsome animal, was to be found only in two small and widely separated districts. Since the Sudan range was more accessible, the expedition, consisting of Dr. James L. Clark, C. Oliver O'Donnell, W. T. Hunt, John W. Hope, Dudley Blakely, and Jack Robertson assembled at Khartoum in February of that year to outfit their expedition. From there they sailed up the Nile 860 miles to Shambe, a little river station, from which outpost they were to set out for the back country in search of the elusive giant eland.

"Deserving your eland"

Little or no information about this giant antelope could be found in Khartoum or farther south than the Sudan since few people, even among the local officials, had hunted it.

They were told in Khartoum, "If you get your eland, you will have very well deserved them." With this scant information and with hints as to their whereabouts picked up by Doctor Clark some years before, the hunters proceeded one hundred miles westward from Shambe to Rumbeck. There they were advised to go another fifty miles farther west to a spot known as "York House." This regal name was applied not to a mansion or stately outpost, but a simple grass hut by a water hole where the Duke and Duchess of York, on a previous visit, had established this camp to try for lions.

There the O'Donnell-Clark Group by good

luck jumped the only herd in the country, on their first day. Their good fortune, however, was only of eight hours' duration for, after trekking the herd for that period of time, not a single chance of a shot presented itself and the herd moved on into the wilderness.

The heat was so extreme and the conditions of living were so bad there that the expedition set out the next morning for Amadi Post where they again reassembled and proceeded sixteen miles out to one of the rest-camps which was assigned to them by District Commissioner Cann of Amadi. Several days of hunting disclosed nothing but a few old tracks of a herd that had long since passed that way. As Doctor Clark wrote in *NATURAL HISTORY*, November, 1931: "After seeing this eland country, I began to realize the great part luck would play in our success, even though we hunted hard and conscientiously. The first thing was to locate the eland; second, to see them first; and third, to see enough of them to pick the desired specimen."

A limited privilege

The expedition possessed licenses to shoot only two eland. At least four would be needed for the group and the extra two were subject to a fee or "export duty" of five hundred dollars a head. With a misplaced shot costing five hundred dollars, their difficulties became intensified.

In this country thickly but evenly covered with small trees and bush, no long vistas could be found—about seventy-five yards was the length one could see on the average. A switch of a tail, the movement of a single ear suddenly come upon was all that could guide them. The eland never stop to feed. The herd travels zig-zaggedly only to reach for leaves or to break down with their horns the small trees which bear their food.

After three days in such difficult country, the bearer spotted a herd of eland during one of their trips, but before they had time to sight an individual animal, the herd had their scent and were off. The next day and the day after they hunted in different directions and devoted what time they could to the collecting and preserving of accessories while O'Donnell hunted by himself for three days. Two weeks had now gone by, and still no eland. Then one day fresh tracks were seen of a single animal. Carefully they trailed him but always he eluded them in the heavy grass and thick underbrush.

A second track was found and as they stopped to examine it their guide sighted the herd—or what they hoped might be the herd. About 150 yards to their left there was part of an eland visible through a spot in some thick bush. Doctor Clark dramatically tells of its capture.

A dramatic capture

"Here we were—clean in the open, with hardly a blade of grass to shield us. How we had gone this far without being detected and how the shikari picked up this tiny spot is one of those breaks in hunting that can't be explained and which we call 'luck.'

"I looked through my glasses, but all I could see was a single spot of tan. I could not distinguish just what part of the animal it was, but I was sure it was an eland. Then to the right my eye caught the swish of a tail. This gave me his general position, and looking at the other side of the spot, I saw the tip of a horn. Everything else was a wall of leaves.

"Apparently he was facing left and almost broadside. Fortunately the same leaves that shielded him also shielded us from his view.

"Although I searched the bush for others, not a sign could I find and I turned again to study his position. At last I had an eland before me, but was it what I wanted? I suspected I saw the tip of the other horn, and slowly edged my body sidewise to locate the head, if possible. I saw a big ear swing into view and from its position figured he must be looking our way, yet I could see no part of the face and not until this ear changed its position did I dare to move. When the ear swung back, a tip of horn came into view and from this I finally put together the puzzle of his head.

"The patch we saw was part of his shoulder and from what I saw of the tip of the horn I figured it was undoubtedly a bull, but was too small for the group. At one time I decided to let him go and to try for a bigger one. Then I began to reflect upon the days I had trod the ground with never the sight of one, and here was my first chance, the only shot I had had presented in all the fifteen days of hunting. Finally I said to myself, 'Don't be a fool. Here's a bull eland, and you may never see another. Take him!'

"I could see the point of the elbow and a bit of the brisket and from these I judged the position of the heart. Cautiously I changed my glasses for my gun and slowly brought myself

to a sitting position. Now I was ready to shoot.

"With my mark spotted more by the bushes than by the now indistinct body, I took aim, but I was inwardly too excited, and the front sight would not settle down to quiet. I began shaking like a leaf. I was getting buckfever. I dared not risk the shot, so I took the gun from my shoulder.

"It was with supreme effort that I recollected my scattered nerves and calmed myself to steadiness. Then, holding my breath, I began to squeeze the trigger as I held the gun with braced elbows on my knees. It finally went off and at the report I saw the animal jump and a pair of heels fly into the air. Somehow I was confident, but rushed ahead to follow through.

"When I neared the spot, I saw through the bush my eland lying motionless and, to my great surprise, there stood two more fine bulls but a few yards away. Startled by the ring of the shot and their comrade's fall, they stood and watched me. Hurriedly I looked them over. I had by sheer luck drawn the best."

The task not ended

The camp was a happy, buoyant place that evening. Although another full week was wasted going and coming from other eland grounds farther west, without sight of another herd, the hunters toiled on. They were to sail from Shambe on April first and the days had sped by until it was now March 29. They had hunted a total of 220 miles on foot and had not seen another herd from which they might hope to get an eland cow for the group. Food was about gone, for things had been timed to wind up on this day. On the morning of the 29th the gray, dull light and recent rains made ideal hunting weather. For two hours they skirted the country about their camp where they had gotten their first bull. Suddenly they sighted a herd coming straight toward them, but again their problem presented itself. But one shot was possible and that would have to be a cow. Just a few steps in front of the hunters one such animal raised her head. A slight turn to the left and she presented her shoulder just as Doctor Clark pulled the trigger. She was so close that with one lunge she could have pinned him to the ground. As the shot rang out confusion reigned and eland broke in all directions. The cow

wheeled, but another shot brought her down for good.

The O'Donnell-Clark expedition had found their "needle in the haystack."

The sable antelope

The magnificent Sable Antelope Group was obtained by the Vernay-Angola Expedition.

Although they were obliged to hunt these animals during the dry month of August, when tracking was most difficult, Mr. Vernay succeeded through persistence in shooting the splendid specimens that are now in African Hall. After three days' reconnaissance in the sable country, Messrs. Vernay, Lang, and Boulton made their camp on the Teti River not far from the salt pans near Chisongue.

"I had with me young Alan Chapman who was born in Angola," wrote Mr. Vernay in *NATURAL HISTORY* in November, 1927, upon his return from Angola.

"It was for his grandfather that the Chapman zebra was named. Our plan of attack was that Alan should go north and I south, he go west and I east, or whatever arrangement might be best so that we should cover the whole country as much as possible. The first day out I was rewarded by getting two cows, one old cow and one young cow who had had one calf. The next day a calf was the bag.

"Two days after that Alan obtained a young bull with 39-inch horns. And time went on—and our anxiety increased as we now had only three days left; I decided to send Alan to camp on the Tunda River, which was about fifteen kilometers away, as only a few days before I had seen tracks of a large bull which I thought he might possibly find. In the meanwhile I covered another part of the country. The understanding was that he was not to return until nine o'clock of the morning we had to break up camp. This would allow him a few hours after daybreak to make a final hunt before reporting.

"I had no news from Alan, and finally had only one day left. After having made a fairly thorough inspection of the country, I considered it almost useless to go out the last day—the natives' feet were in bad condition and we were all tired—but finally I decided that we would make one last attempt and make a big detour around a feeding ground where I had seen a large bull at dawn a few days previously.

"I started out at a quarter to five with Sakafuta, an Ombundu native, and one other. At a quarter past seven I saw to the left, about 150 yards in the bush, a magnificent bull sable walking majestically through the bush, returning from the feeding ground. Sakafuta and the other native had not seen him, as they were looking in the other direction. However, at a signal, they immediately went down on the ground and disappeared in the grass, which was up to our waists. The bull in the meanwhile disappeared behind a large dead tree which had fallen. It was an anxious moment, wondering whether he would keep on or possibly turn away into the bush, which would mean that I should have to move and he probably would see me. However, he fortunately came out from behind the tree and was shot. In this way a magnificent specimen was obtained, which complemented the group of the sable antelope."

A foretaste of what the American correspondents are experiencing in Abyssinia was obtained by Morris and Sydney Legendre, Gertrude Sanford, and T. Donald Carter when they set out to secure specimens of the Abyssinian nyala—"The Queen of Sheba's Antelope"—in 1929.

Camping out in southern Abyssinia provided plenty of thrills and the elusive nyala. Mr. Carter and Sydney Legendre each secured a bull and Sanford secured two does. As they describe the shooting of the first big bull, "He was

sighted a little after sunrise, and was followed all day, yet, although he was always kept in sight, he was never close enough for a shot. At sunset he seemed to disappear altogether. Suddenly, just as the party was about to return to camp defeated, he appeared silhouetted against the sky. The range was rather long and the light practically gone, but as it was their last chance, they decided to shoot. The first shot, a lucky one, dropped him in his tracks.

"In one day Mr. Carter had six animals to skin out and care for. The natives helping him were practically useless. Doing very little, they nevertheless managed to do it carelessly, so that he was forced to go over everything they touched. Often he worked a day and night without stopping, and it is due to his untiring efforts and skill that we were able to bring back to the Museum the skin of every animal we shot."

Mary L. Jobe Akeley

The chronicles of African Hall would not be complete without mention of the earnest participation of Mrs. Mary L. Jobe Akeley and her constant enthusiasm which has brought substantial support to the project. The reader is referred to Mrs. Akeley's books for further information, and to volumes XXV, XXVII, XXIX, XXX, and XXXI of *NATURAL HISTORY* which carry other stories of African Hall expeditions.



A Pre-View of Eight Groups in the Akeley Hall of African Mammals

The following photographs were selected to give some idea of African mammal life as it will be displayed upon the opening of the new hall to the public early in 1936.

Although the hall will not be completed at that time, enough of the large and spectacular exhibits will have been finished to warrant admitting the public. All of these completed groups are to be found on the second floor of the African Hall, but progress on the third floor, or balcony, justifies the prediction that some of those habitat groups as well will soon be available to the visitor.

The photographer in his selection of the details to be pictured and in the use of special illumination has achieved results which speak for themselves, but it is impossible to do full justice to the beauty of the groups through the medium of photography, and the visitor should find these transplanted portions of Africa exceeding any expectations aroused by the photographs.

All of the groups in the Akeley Memorial African Hall have been assembled under the direction of Dr. James L. Clark, and the scientific direction of Dr. H. E. Anthony.

*Text by H. E. Anthony
Photographs by Wurts Brothers*



ANIMALS by John W. Hope.

BACKGROUND by C. C. Rosenkranz.

FLORA AND FOREGROUND by Albert E. Butler, assisted by George F. Mason and Joseph M. Guerry

The Giant Sable

sentinel for the herd will be a young bull. It is said that formerly, in South Africa, the sable traveled in bands of as many as fifty or sixty animals, but today the sable of Angola may be found only in much smaller groups. Usually there is but one large, mature bull with a herd of cows and young animals, although the sexes will be about equally divided. Half-grown bulls with much smaller horns will be tolerated by the herd bull.

The giant sable prefers brushy plains, lightly forested stretches, or low, hilly districts. It does not wander far from areas of at least scrub vegetation and is not found out on the open stretches of the great Kalahari Desert. It comes regularly to water and is least active during the heat of the day.

At the time Mr. Arthur Vernay collected the specimens shown in this group, August, 1925, the giant sable was already becoming scarce. Mr. Vernay experienced no great difficulty in getting the cows, calf, and young bull, but could not locate a big male, one with horns more than fifty inches in length. By the fortune of the chase, the big bull was secured on the last day of hunting before Mr. Vernay had to leave Angola. Luckily for the Hall, this individual had truly magnificent horns. Although not a record, a head as large as this is an achievement for recent years. The dwindling numbers of giant sable, the fact that they are limited in their range, and that hunters are eagerly seeking the big heads, all operate against the production of horns as large as those of former times.

THE giant sable (*Egocerus niger varians*) with its fine, upstanding carriage, its impressive, curving horns, and its appearance of alert awareness is one of the most spectacular of all the antelopes. The members of the genus *Egocerus* (sable and roan antelopes) stand relatively high at the shoulder and have the appearance of being up on their toes and ready to go.

This physical appearance of vigor and watchfulness is well supplemented by sharp senses, the power of vision being especially keen, and by a disposition unusually aggressive for an antelope. The sable is one of the very few antelopes that will, when wounded, charge man.

The sable antelope shown in the group, the giant subspecies, sometimes called Varian's sable or the Angola sable, is to be found only in Portuguese West Africa, in Angola. Other races of the sable antelope occur from the Transvaal and Rhodesia north to Tanganyika and Kenya. Unfortunately, the giant sable has been so reduced in numbers that it is not far from extermination. Habitually, the sable antelope runs in small herds, although an occasional old bull may be observed traveling by himself. Such individuals usually are extremely wary. Captain Gilbert Blaine, an authority on Angola, states that he has not noted the giant sable occurring as a solitary old bull, but has found two young bulls, probably driven out of the herd, traveling together, very shy and watchful. According to his experience, the



The cross-hatching indicates the site of the Group



The Gemsbok

THE gemsbok (*Oryx gazella*), sometimes anglicized to gemsbuck, is the largest of the genus *Oryx*, the group of antelopes carrying long, slightly curved horns. All of the *Oryx* are handsome mammals with compact bodies, businesslike horns, and rather showy markings; and at the top of the list stands the gemsbok.

This antelope shows a preference for desert areas and is at home in southwestern Africa from the Kalahari Desert to the northern limits of the Cape Province. Because of its specialization for a desert environment, its ability to obtain the water it needs from the vegetation upon which it feeds, more particularly a variety of wild melon, and the inhospitable character of these desert regions for human occupation, the gemsbok has not, until recently, suffered unduly from persecution by man, and still exists in numbers over much of its range. The advent of the motor truck, carrying a water supply, has brought a menace to the mammal life of the Kalahari, and the gemsbok has already begun to suffer from this attack upon its natural sanctuary.

With the gemsbok, as with other *Oryx*, the horns of the female are longer although not as heavy as those of the male. A maximum length of four feet along the curve is recorded for this antelope. The spearlike nature of these horns makes them formidable weapons and the gemsbok is an aggressive believer in their use. When wounded, it does not hesitate to charge the hunter; it is said that it successfully combats

the lion; and during the rutting season the males fight savagely with one another.

In common with other plains types, the gemsbok has very sharp vision but seemingly places most reliance upon its sense of smell. These antelopes do not travel in large bands but rather as solitaires and groups up to six or eight in number. A bull may have two cows as consorts and, with the young animals and immature bulls, the family group may hold together to reach this figure. The solitary gemsbok are apt to be old bulls which, because they have no companions to do a sentinel turn, must be continually on the alert themselves and are accordingly difficult to approach.

Despite a general lack of water on the Kalahari and the fact that it is truly a great desert, there are considerable stretches of scrub vegetation and occasional "pans" where water may be found at certain seasons of the year. The mammal life of the Kalahari comes to these "pans" for water when it is available, but the observations of men who know the region indicate that the gemsbok wanders at will and need not base its choice of range upon the presence of water.

The name suggested by the early Dutch settlers for this sharp-horned antelope gemsbok, is rather peculiar when one considers its original meaning. The Dutch called the chamois a "gems" and the English equivalent of "bok" is buck, so "gemsbok" means a buck chamois; but there is very little about the African species suggestive of the small antelope of the Alps.



The cross-hatching indicates the site of the Group



ANIMALS by John W. Hope.

BACKGROUND by C. C. Rosenkranz and Dudley M. Blakely.

FLORA AND FOREGROUND by Albert E. Butler, assisted by Dudley M. Blakely.

The Mountain Nyala

preservation of the species, it is not convenient for the average hunting party to make the long and difficult trip up to a timber line so removed from railroad or motor transport. Accordingly, few white hunters seek the Queen of Sheba's antelope.

During the hours of high sun the animals are in the forest or thickets and then wander out into open patches late in the afternoon. Here they feed, browsing on heather principally, although grazing occasionally upon grasses, until sunrise of the next day. Mountain mists sweep the slopes at times and serve to protect the nyala from the vision of the hunter without handicapping the antelope to any great extent, because the latter rely upon a keen sense of smell. It is said that when out in the open, they are noticeably more shy and wary than when among the trees, and if pressed too closely, they may climb above the heather into the barren, open terrain of the mountain-tops where they have a decided advantage over any pursuer. Lions do not occur in the region where the mountain nyala lives, and the leopard is not common there; hence these antelopes have little to fear from any creature other than man.

This antelope is related to the nyala (or inyala) of southeastern Africa, a handsomely marked representative of the bushbuck family. The similarity of names is confusing, but the inyala has smaller horns and lives along river banks in the lowlands. Still another name for this southern nyala is Angas' bushbuck.

THE mountain nyala or mountain bushbuck (*Tragelaphus buxtoni*) is found only in the mountainous corner of Africa occupied by Abyssinia and even here it is restricted principally to a small area centered about the Arusi district. It is, as its name suggests, a bushbuck that has come up from lower elevations, adapted itself to a high altitude environment, roughly 9000 to 14,000 feet, and has retained the same type of twisting horn. It is, however, much larger than its lowland relatives, carries much heavier horns, and is a much more impressive animal. One of its names, the Queen of Sheba's antelope, indicates its importance among the game mammals of Abyssinia.

This antelope feeds on the high mountain slopes and rolling uplands where the dominant vegetation is giant heather. It is also found in the forest which lies along the slopes before the zone of heather is reached. In this forest the bamboos are a prominent feature. This is a region of temperate characteristics in that nights are cool, often with the thermometer dropping to the freezing point, and precipitation is sufficient to encourage green vegetation. At midday the sun may become quite hot, thus causing the daily range of temperature to cover a wide swing.

The mountain nyala occurs singly or in small bands up to six or eight in number. Apparently the total number of this species is not very great, for the animals are local in distribution and restricted rather closely to a specialized environment. Fortunately for the



The cross-hatching indicates the site of the Group



ANIMALS by Robert H. Rockwell.

BACKGROUND by Wm. R. Leigh.

FLORA AND FOREGROUND by Albert E. Butler, assisted by George E. Petersen and Robert W. Kane.

BIRDS by Raymond B. Potter.

The Greater Koodoo

down the great spiral horns and into the ear. This species may be seen in small bands or as solitary individuals. It does not group into larger herds as do some of the plains antelopes, and usually the females greatly outnumber the males. The old bulls with the finest heads are relatively scarce, and because more molested by the hunter, are more secretive and more difficult to observe.

It is not likely that the greater koodoo often falls a prey to enemies other than man. Its habitat preference keeps it out of regions where lions abound, but the leopard lives on some of the rocky slopes in the koodoo range, and against this cat the young koodoo and the hornless females must be on their guard. Not infrequently greater koodoo may be noted in areas where the natives run their herds of goats and sheep. If the number of these domestic animals is not so great as to take all the feed, the koodoo remain in the region, moving out of the way when a shepherd and his flock passes, but not disturbed or alarmed to the same extent as would be our North American big game under similar circumstances. In addition to grazing upon grasses, this antelope feeds upon the fallen fruits of certain trees and otherwise supplements the meager grazing possibilities of arid hillsides.

In the records of large game heads, the specimen of the greater koodoo listed at the top has horns 71½ inches in length, and, below this are seven heads each exceeding 60 inches in horn length.

THE greater koodoo (*Strepsiceros strepsiceros*), often spelled kudu, carries the longest horns of any of the African antelopes. In size and impressive character of horns, it is approached only by the sable antelope, the giant variety of which possesses great, sweeping horns but a few inches shorter. Greater koodoo are large animals and have a body size well proportioned to set off the great spiral horns to best advantage.

These antelope are to be found over a large part of Africa south of the limits of the Sahara. In some parts of South Africa, notably Cape Colony, it has been exterminated, but over other parts of its range it is still fairly common although local in its distribution. It frequents hilly or broken country which it seems to prefer to plains. It does not live in the heavy forests of the Congo, its favorite habitat being the brushy hillside, where it is adept at concealment and well protected by its neutral coloration. Good koodoo territory is usually very dry but with water accessible either at a river or water hole.

Greater koodoo are shy, wary animals, most active at night, early in the morning, and late in the afternoon. As the sun rises, they retreat into the shade of a thicket, where they spend the midday hours. When feeding, they wander out of the thorny jungle into the openings to graze, but when alarmed they take full advantage of all the cover available. They are said to be very acute of hearing. One hunter has suggested that the sound waves are conducted



The cross-hatching indicates the site of the Group



ANIMALS by Robert H. Rockwell.

BACKGROUND by Wm. R. Leigh.

FLORA AND FOREGROUND by Albert E. Butler, assisted by George F. Mason and Joseph M. Guerry.

BIRDS by Raymond B. Potter.



The cross-hatching indicates the site of the Group

The African Buffalo

THE African buffalo (*Syncerus caffer*) is one of the group of wild oxen, all of the members of which are more or less closely related to the domestic ox. This particular variety of wild ox is one of those less intimately related to barnyard cattle in physical characters and the contrast is even greater when applied to behavior. The African buffalo bears the reputation, rightfully acquired, of being one of the most dangerous large game species for man to hunt. Fierce and intractable in disposition, possessed of great vitality, and clever in selecting the place and time for a charge, this animal has brought many a hunt to a tragic end.

The African buffalo is widely distributed over Eastern Africa, from about southern Abyssinia to the Cape of Good Hope, where it is usually to be found near water. Environment to its liking may be found from the warm coastal plains up to elevations of 10,000 feet in the mountain ranges. In open, desert-like situations where water is scarce, buffalo do not occur.

The African buffalo is social in habit and the animals are found in herds the size of which varies from ten or a dozen to one hundred or more. The herd is composed of both sexes and apparently no one bull dominates the herd to the exclusion of all other bulls. The horns of the cows are not as massive as those of the bull and, while the former will charge an enemy upon slight provocation, the bull has the reputation of being more vindictive and less

easily swerved from his purpose when pressing a charge home.

These buffalo feed mostly at night and lie up during the heat of the day, often in some marshy spot such as is portrayed in the group. Toward sundown they come out of cover to graze; after sunrise next morning they move back en masse from the feeding grounds into a thicket of brush or whatever vegetation the region affords. If the locality is one where water is to be found only at a river, buffalo will drink just before retiring for the day and may move back several miles before taking their rest.

The African buffalo is alert and must be stalked with care. All of its senses are keen, and the man who would observe this animal must guard against a quick eye, a sensitive nose, and a perceptive ear. The animal does not customarily charge unless it has been attacked, although there are records of unprovoked attacks upon people.

The African buffalo has suffered far more from the ravages of disease than from the attacks of man or other large animals. On several occasions outbreaks of epidemic violence have made heavy inroads upon the members of this species, one of the most serious of these taking place in East Africa late in the nineteenth century, when it has been estimated that not one in ten thousand was left alive. That the remnants were able to reestablish the present large numbers is a striking illustration of the vigor of the species.



GIFT OF MR. AND MRS. G. LISTER
CARLISLE

ANIMALS by James L. Clark.

BACKGROUND by Wm. R. Leigh.

FLORA AND FOREGROUND by Albert E. Butler,
assisted by Dudley M. Blakely, Joseph
M. Guerry and George F. Mason.

The African Lion

the men working on a railroad project, killing many until they, in turn, were killed by Lieutenant Colonel Patterson.

The favorite food of lions is zebras, wildebeest, hartebeest, and other antelope of similar size and general habits. Lions sometimes lie near water holes to ambush animals as they come to drink, but often stalk close enough through tall grass or thick brush to permit of a final short rush. This rush of a stalking lion, or the charge of an angered one, is of great speed, but this speed cannot be sustained for any great distance.

In some parts of Africa where conditions are ideal for the lion, where there are great numbers of the species upon which the lions prey, and where the everyday association of lion and game herds has accustomed the herbivores to the necessary presence of the big carnivore, the animal world shows a surprising disregard of the lion. Lions may be in full sight of antelope which do not stampe as long as the cats are indifferent, and species like the reedbuck or bushbuck may use the same thicket in which lions lie up for the day.

Family groups of lions are frequently seen. Apparently, a lion and lioness may be mated for a long period, perhaps permanently, or one male may have several females which, with their cubs, will constitute a group of a dozen or more.

The lioness has from two to six cubs in a litter, but the usual number to be seen with a wild lioness is two or three.

THE African lion (*Felis leo*) has been described under various subspecific names. These geographical races differ but slightly from one another and to the layman there is but one lion, the African lion. A lion occurs in Asia, a few are still extant in India, but in this instance also the variation in geographical range is correlated with but slight physical differences.

Formerly, a good photograph of an unstrained lion was a prized trophy rewarding a patient and lucky stalk. Today there are well known districts where the photographer can drive in a motor truck and be certain of photographing not one but many lions. Along with the increase of splendid photographic records of the king of beasts has come an accumulation of life history data, in many cases with motion pictures to describe behavior.

The lion is to be found in practically every large-game field in Africa with the exception of a few regions where it has been exterminated. It does not go into heavy rain forest nor into the heart of desert areas where game is too scattered to prove a reliable source of food. Within recent historical times it has disappeared from the countries bordering the Mediterranean, and even later from the Cape Province.

In general, the lion does not molest man unless it is attacked by him, but individual animals, for one reason or another, may become man-eaters. The most famous of these were the lions known as the "man-eaters of Tsavo" and in this instance two animals took toll of



The cross-hatching indicates the site of the Group



ANIMALS by Robert H. Rockwell.

BACKGROUND by F. L. Jaques.

FLORA AND FOREGROUND by Albert E. Butler,
assisted by Joseph M. Guerry.

The Bongo

mammals to stalk and observe.

Several races of this antelope have been described, the one shown in the group being the eastern race, *Boocercus eurycerus isaaci*.

The eastern race makes its home in forest where bamboo grows in extensive thickets. The undergrowth is thick and the cover so dense that not only is it most difficult for man to travel there, but also impossible for him to see into it for more than a few feet. In spite of the large size of the bongo, it is able to pass through this jungle at a surprising rate of speed and to move about, when skulking, without the noise which even the most skillful hunter must make under such circumstances. The keen senses of this antelope and its mastery of a difficult environment have kept it from falling to the rifle of very many white hunters.

While the bongo may rest, lying down to chew its cud, during the middle of the day, the natives say it does all its feeding during daylight hours. As there is no oppressive exposure to the direct rays of the sun in these humid forests, and the bongo is able to detect the coming of an enemy well in advance of its arrival, there is little need for night activity.

The bongo are apt to run in herds but these are not large; because of the thick cover, observations on the actual numbers are wanting, but it seems to be of common occurrence to find several animals together. Major Maydon, hunting bongo in Kenya, writes that he believes the big old bulls are very apt to travel by themselves.

THE bongo (*Boocercus eurycerus*) is the deep-forest representative of the tragelaphine antelopes, the group of antelopes with spirally twisted horns typified by the bushbuck, koodoo, and eland. With its glorious brown to black pelage and well-proportioned body, it is probably the handsomest member of the group, although its horns lack the inspiring length of those of the koodoo and the massive character of the eland horns.

The bongo is never found out of heavy forest and its proper environment is deep, primeval stands of timber such as are associated with great rivers like the Congo or with humid mountain slopes. Roughly, its range extends from Liberia, the Gaboon, and Sierra Leone, through the forested land that follows the Congo drainage, east to Uganda, and along the Mau Escarpment to Mount Kenya. Throughout this area precipitation is favorable to luxuriant plant growth and in many sections the rainfall is very heavy. It is not uncommon for mammals of humid districts to show a marked tendency toward dark coloration. With the bongo, the dark pigment is a rich brown quite distinct from the color of other tragelaphine antelopes, but the common ancestry may still be detected in the presence of stripes and white throat-bands. Roosevelt and Heller consider it to be most intimately related to the eland. The coat of the bongo blends well with the dark forest environment and is of great value to an animal naturally wary and watchful. It is one of the truly difficult African



The cross-hatching indicates the site of the Group



ANIMALS by John W. Hope.

BACKGROUND by Wm. R. Leigh and Dudley M. Blakely.

FLORA AND FOREGROUND by Albert E. Butler, assisted by Dudley M. Blakely.

THE giant eland (*Taurotragus derbianus*) is the largest of all the antelopes. In body size it is as large as a domestic ox. While the giant eland is scarcely any larger than the common eland, with respect to body size, its horns are larger and more massive.

This species has a restricted range and is not found outside of a small area lying between the White Nile and Bahr-el-Ghazal and a similar circumscribed area in Senegal. Even in these regions the giant eland is not plentiful, and the total number alive today is relatively small. They run in small herds of from ten to thirty or forty, and because of their scarcity and local distribution, it is often very difficult to locate the animals.

The giant eland prefers dry plains of thorny scrub. It is a browser rather than a grazer and feeds upon the leaves of trees and shrubs. Often it breaks down branches to get at the foliage, and by using its horns, it can reach as high as seven or eight feet from the ground. The animals are great travelers, pulling off leaves while on the walk, and covering many miles in acquiring a meal.

Like many of the species of African mammals, the giant eland goes to water just before dawn and then, fortified against a dry, hot day, strikes back from the water into a dry back country. The terrain frequented by it is rather more arid than that preferred by most other antelope, and its ability to cover long distances between water holes makes this animal all the more elusive.



The cross-hatching indicates the site of the Group

The Giant Eland

It will be observed that both sexes of giant eland carry horns, and although those of the cow may be as long as those of the bull, they are not as great in diameter and lack their massive character. The twist in the horns is characteristic of members of the subfamily of antelopes which includes bushbucks, koodoos, bongos, and elands.

The giant eland is wary, and the gray to tawny color of the pelage which blends into the background of thorn scrub through which it travels aids it in escaping observation. Not much other game is to be found in good giant eland country, and a hunting trip for this species must, perforce, be organized for the one animal alone, especially since shooting at the occasional roan antelope or hartebeest encountered would frighten the shy eland out of the country.

Its greatest enemy is man, since it is too wary and strong to be stalked successfully by lions. Unless the lion can approach by stealth (a difficult matter in the type of country where giant eland live), close enough to bring the first rush of the cat to the head of the eland, the latter is strong enough to shake off the lion. This antelope is not capable of any great burst of speed but, when frightened, breaks out of an ordinary walk into a fast trot. The maximum effort results in a gallop, but this is not sustained for any great distance.

Much of the territory inhabited by giant eland is also sleeping sickness country, a fact that has operated to keep hunters out.



(Above) Mr. and Mrs. Martin Johnson at camp in the gorilla country, which Akeley called "the most beautiful in the world"



Carl Akeley using the camera which he invented. It proved invaluable for work in the field

Camera Safaris

How the beauty of African wild life and landscape has been captured by the photographic lens and made its contribution to the Akeley African Hall

By MARTIN JOHNSON

All photographs by Martin Johnson

THE enthralling creation of African Hall first concerned Osa and me in about 1922. We had just returned from our first African safari; our feature film "Trailing African Wild Animals" was completed and about ready for the market, but we wanted it gone over and given the stamp of approval before being released; this had to be done by an African expert, and of course this could be no one but Carl Akeley whose exploits in Africa were known by everyone interested in the so-called "Dark Continent."

Carl Akeley

Accordingly I made arrangements through a mutual friend to meet Mr. Akeley, and on reaching his offices in the American Museum, I found him at work on his lion spearing group. At this time he was just starting the clay models from which the bronzes were to be cast. His Nandi spearmen were composites from original models he made in Africa, photographs, drawings, and selected types of American negroes which he was using to make sure of perfect figures. I will never forget the pride I felt when he asked my opinion as to the forms of the many negroes he inspected. They must be figures as near the perfect type of Nandi as it was possible to get, and when he asked my opinion, I was forced to use great caution, for Osa and I had spent only two years in Africa, and very little time among the Nandi tribes. Most of our experience with savages up to this time had been with the natives we had encountered during the nearly ten years

we had spent in the South Sea Islands and in Borneo.

The first few hours at the Museum I was in the presence of *Mr. Akeley*, but through that rare charm and feeling that he had, probably because of our mutual interest in wild things and of course in photography, it soon was "Carl," and never again did I think of him in any other way.

I now became an almost daily visitor at the Museum. Carl in turn visited our apartment and had many a dinner with us, always having a romp on the floor with "Bessie" our orang outang, and "Kalowatt" and "Wah" our two gibbon apes.

I knew that I never made a nuisance of myself and was never in Carl's way. He made me feel that. We had one of those understandings whereby we could be together for an hour without saying a word as he worked on his lion spearing models or on the mounting of his Gorilla Group. Or I would sit and watch him and listen to his stories of African adventure, of his plans for the future, and most interesting of all, his plans for the African Hall.

Early planning

I wish it were possible for me to state just when Carl's African Hall idea started, but I don't know. I know his ideas were well under way when I first met him. He had small models of the proposed building, the groups, the bronzes, and all the details that he visioned in the completed hall, but each day as we would talk he would make additions to his details, change or elaborate them.

It now seems to me that Carl was just then

forming the actual model in his own mind. He was constantly getting new ideas that would change the ideas of the previous few days, but two of his thoughts stand out above all the rest, African Hall *must* be Africa, it must be true in every detail, and it *must* be done according to the new and modern methods of taxidermy. As he told me:

"Everything that has been done in the American Museum of Natural History in the way of African exhibits must be thrown out and completely discarded; we must start all over again."

As I look back to those weeks when I listened to Carl's plans, I marvel that everything has worked out just as he planned, even to the finest detail.

"I want to collect the groups myself," he told me. "I will take an assistant taxidermist along, and he will teach native skinners to work under us and do the work according to our ideas. Then I will have a couple of painters; they must be the best men in their line; one a landscape painter to get the scenery, the grass, the trees, the background, everything as perfect as it is possible for man to reproduce nature. Then another painter to do the animal studies and to work in the background, and an accessory man to collect the trees, the rocks, the pebbles, samples of the trees, bushes and grass."

Then he spoke of the photographic work necessary to supplement the measurements he would take of each animal before it was skinned. He wanted scores of pictures showing every contour, muscle and joint, every posture at rest and in motion.

"Tame" pictures most difficult

I doubt whether any one who has not tried it has any conception of the difficulties connected with making wild-animal pictures. The easiest thing to do is to shoot an animal with a high-power rifle at a comfortable and safe distance, or to run it down with a motor car, picturing the process and its excitements. The hardest thing is to picture that same animal in a calm, undisturbed state of nature. But we had worked out many of the problems on our first trip, and had thought out various new schemes we were eager to try.

Never have I spent a more interesting three months than during this time that I visited Carl almost daily. African Hall was the dream of his life. He was dreaming and planning

ahead toward the time when he could get back to Africa and start his new work, and his dreaming caused me to dream. In fact, it was his thinking out loud that was responsible for the pictures and books that Osa and I have brought out of Africa since then.

Necessary backing

The photographic program which I worked out would require several years and a considerable outlay of money. The details of organization were complex. It was Daniel E. Pomeroy who came to our assistance. He had seen our film, "Trailing African Wild Animals," and was especially impressed with the photographic opportunities in Africa. He established a corporation, and provided \$150,000 for our work.

Then we found ourselves on the way back to Africa where we were to remain for nearly four years while making "Simba." Osa and I built our grass home at Lake Paradise and a couple of years later Carl returned with R. H. Rockwell, his assistant, R. C. Raddatz, to collect the accessories and help in the taxidermy work, W. R. Leigh to do the background painting, Arthur Jansson to do the animal studies, and Mary Jobe Akeley, his wife, to attend to the business details.

Carl was in Nairobi several months before Osa and I were able to get down from Lake Paradise. We found Carl and his assistants working on their first group, not far from Nairobi. The rains were on and he did not care to get too far away until the country dried up, making traveling easier. Then again he wanted to be in Nairobi to meet George Eastman and Daniel E. Pomeroy, who were on their way out for a combined big game hunt and to help Carl in securing the groups.

Mr. Eastman, Mr. Pomeroy and Dr. Audley Stewart arrived, and moved to the house the Akeley's were using at the edge of Nairobi. Osa and I were living at the old Norfolk Hotel, but most of the time were out at the house helping prepare for the first safari out of Nairobi. The rains were on—and I mean on, too! It seemed as though these rains were doing all they could to embarrass me, for I had impressed on all concerned that they should be in Nairobi by the middle of May in order that all arrangements could be made to go on safari by June 1, the official time for them to stop. But it rained and rained day after day. By the middle of June it was still raining and every-

one was getting impatient, so it was decided that we would make a short safari into the Kedong Valley about forty miles from Nairobi, encamp there, and help Mr. Eastman secure a few trophies.

After a few weeks in the Kedong Valley we received word that the rains were stopping in the north country, so Carl and his safari pulled out first and made camp at a water hole on the Kaisoot Desert, a short distance north of the Guaso Nyiro River.

A real beginning

About ten days later the rest of us came along on the way to Lake Paradise. We stopped a night with Carl and here I saw the first actual work that was to result in making Carl's dreams come true. Mr. Leigh showed us the first paintings he had made, and I watched Carl and Rock and Raddatz at work on the first giraffe skin.

Leaving Carl and his staff at work at the water hole, the rest of us, including Philip Percival and Pat Ayers, safaried up to our home at Lake Paradise, then we returned by easy stages to Carl's camp again, stopping at various water holes for pictures and for a few trophies that both Mr. Eastman and Mr. Pomeroy wanted. Mr. Pomeroy secured a beautiful lesser koodoo, and Mr. Eastman secured a most interesting picture of a rhino charge. We saw a few elephants. I made the best leopard flashlight I had ever made, and Mr. Pomeroy shot his first lion.

It must be realized that a camera safari is a much more pretentious and exacting undertaking than a mere hunt where one is concerned only with food and ammunition. The photographic equipment alone runs to considerable weight and it must be carried in duplicate to guard against losses and accidents.

The problems encountered are many and complex. The camera makes certain demands. There must be fair light. The shadows must fall right, else the picture will be flat and uninteresting. The angles of view must be selected so as to avoid bald skies and awkward compositions. The footing must be stable and steady lest vibrations mar the picture. And that is only the beginning. The blind must be built to windward of the water hole so that the scent of the camera man does not reach the animals on some wafting breeze. If possible, the blind should be slightly higher than the spot to be pictured, because the scent, carried by the rising

heat of the body tends to go upward. Also the blind must be as perfect a bit of camouflage as possible. The animals have a critical eye. They do not admire a conspicuous blind. It offends their taste in landscape and challenges their sense of discretion. They do not enjoy having their Africa tinkered with. They do not like the click of a camera either. They never consciously get confidential with a photographer. African animals have only two lines of action with reference to the camera. They either run from it or at it. Neither treatment is entirely satisfactory to the man behind the camera.

Many animals can be photographed from blinds, such as most antelopes and the other grazing animals like the giraffe and zebra. Also now and then one gets a chance at the lions and leopards and other beasts of prey which follow the herbivorous animals to the water holes. But there are animals in Africa which seldom or never drink—the gerenuk for instance. It is but by the merest chance that such animals stray within the range of a water hole blind. They must be stalked afoot by the camera man. It is always a stern chase, which is notoriously a long chase—with usually nothing more to reward the effort than a handsome rear view of a vanishing animal with his tail waving good-bye as he goes over the hill.

Choosing a water hole

Returning to Carl's camp we found that he had finished curing the skins for his water hole group, but Carl was not satisfied with the water hole setting in which the animals were to be mounted, so we spent a day, just Carl and I, walking to a water hole that I thought was typical of the water hole country of the Northern Frontier. Carl liked it and we made quite a few pictures of it from different angles. The only trouble was that the background in the distance was not good. It was necessary to have some hills or mountains in the distance to complete the sky line.

I knew just the water hole he was looking for; it was on the opposite side of the Guaso Nyiro River, almost opposite his present camp. I gave him the directions how to get there, and it was from this place that the finished water hole setting was made.

Osa and I found it necessary to hurry on into Nairobi, so we pushed on ahead, while Carl and Mrs. Akeley and the Pomeroy-Eastman safari went around Mt. Kenya to the north,

stopping a few days at Embu Swamp where the Buffalo Group was secured.

Then all of us together in Nairobi started getting ready for the long safari south to the Serengetti Plains in Tanganyika. A few weeks later found us camped on the banks of the almost dry Seneraro River, and a little later we moved about a hundred miles to the Guremetti River.

Here on the Serengetti Plains we spent about three months and every day was a full day for all of us. We broke into separate parties in order the better to carry out our individual purposes. Mr. Eastman had by now secured the animals he was to contribute to the African Hall and was busy hunting trophies for his personal collection. Osa and Mr. Pomeroy were busy each day going after the Impalla Group. Carl and his party would usually spend a day securing animals needed for the groups, and the next day in skinning and curing, although I have seen Carl and Raddatz work almost all night through after a lucky day.

I would go after pictures each day and had wonderful success in getting the plains types of game, but no lions. Then one day Carl and Mrs. Akeley suggested that we make a picnic day of it and look over a valley where others in our safari had found a large number of lions. We found the lions—thirteen of them, in what we named Lion Valley. Day after day we photographed them, then we would lay off a day or two so that Carl could catch up with his other work, as Lion Valley furnished only pictures, and Carl must keep his own work moving along.

"Capturing" the color of Africa

One day Osa and I were returning from a long day on the plains; it was late afternoon as we were moving along the side of a hill; the lighting effects were beautiful as we looked away across the plains,—rocky outcroppings in the distance, the S-shaped dry river bed in the foreground, and game in countless numbers quietly grazing in big herds in every direction. In the middle distance were a couple of herds of giraffe, wild beasts all over the place, resembling drawings I have seen of buffalo on the American plains in the old days—zebra, topi, kongoni, Thompson's and Grant's gazelles; down under the trees by the river were waterbuck; a wild pig and some younger

pigs trotted across the open space just below us, their tails in the air like flag poles without the flags,—a most interesting, beautiful and peaceful scene,—just Africa. Osa and I wished we could get a picture of it in color, but this was impossible. Then Osa motioned back of us, still higher up the hill and commanding a better view than even the one we had, and there we saw Mr. Leigh with his easels and equipment for painting; he was getting in color what we could never get with the cameras.

Drafted for a hunt

One morning very early (we were always up and eating breakfast before sun-up), I was preparing to go out for another day with my cameras, when Osa and Dan Pomeroy came up with the command that I accompany them on a hunting expedition for the day. Carl was sick in his tent; some of the groups were nearly finished, but a few animals were missing from various groups. Dan suggested that we try to get these animals, but I was reluctant to go. I was having the time of my life with my cameras; the plains were dotted with animals in big herds, a score of different species, lions were plentiful, and I wanted to make pictures while the sun shone, but Dan and Osa argued that I was working too hard and needed a rest; they could not realize that while I was working hard I was having more real thrilling enjoyment than anyone in camp. However, I was forced to accompany them. At first they were not going to allow me to take a camera along, but I flatly refused to leave camp without at least one camera, so they allowed me to fetch an Eyemo, the smallest of the cameras making regular 35mm professional film.

Now I had a grouch on. As I looked up at the cloudless sky, and then at all the game scattering as we moved across the plains, across little dongas and through small wooded spaces, it seemed that every group of animals was in a more beautiful photographic setting than ever before. It seemed they were tamer than on other days and easier to get close to. I became grouchier and grouchier as we moved along, and then to cap the situation we came upon a small herd of giraffe that moved slowly ahead, to be joined by a few zebra, wildebeest, gazelles, and kongoni. They moved slowly, kicking up their heels and stopping to watch us, then moving ahead as friskily as a bunch of young colts in a pasture. They were so

intent on watching us that they did not notice where they were going, and then they suddenly found themselves cornered in a bunch of big rock outcroppings, in a little horseshoe space, with us covering the exit. The light was perfect, the most beautiful grouping of plains animals I had ever seen. I quickly got my Eyemo ready, started it going, made about three feet of film, then the blame thing jammed. Using language that I don't often use, I opened it up, found the film hopelessly tangled, ripped it out and loaded a fresh roll, and was within half a minute of being ready to make pictures when the animals stampeded and rushed past, and away off on the plains. I was the sickest photographer that ever lived, and even now when I look back over the scene that day, I feel sure it would have made the most beautiful wild animal scene ever taken by anyone.

Consolation

Well, you can imagine that this did not help my disposition. I was such a grouch that I am surprised that Dan did not become fed up and order me back to camp; but he probably knew just how I felt and tried to take my mind off the rotten luck I had just gone through, for he saw a lone wildebeest, a very fine bull, just the one wanted for the Plains Group. He turned to me and said "Get him, Martin; he is the exact wildebeest Carl has been wanting."

Now, I am a very poor shot. I don't care to shoot and consequently I don't keep in practice. I own some very fine and expensive guns, but my favorite is an old 405 Winchester that no one else takes seriously. I have had it for many years, and while, as I have said, I am not a good shot, I do hit things with it—just sheer luck. But usually when I do shoot, I do it when I am alone; then if I miss there is no one to laugh behind my back.

But I was in a bad humor and did not care what happened, so I took hasty aim, pulled the trigger, and down went the wildebeest dead as a stone. Gosh! I was surprised. But I helped place the animal in the motor car, and we started back to camp, as all animals for skinning must be treated as quickly as possible after being shot so that the hair does not slip.

Half a mile farther on, a very fine Grant's gazelle was found half asleep under a tree. Osa stalked to a position where she could get a good shot, pulled the trigger and missed, very unusual for her, as she really is a good shot.

Well, feeling as cussed as I did, I raised my rifle and before Osa could get another shot, I pulled the trigger and down went the Grantie, shot clean through the heart, so clean in fact that he stood there for a few seconds exactly as though he had not been hit. My first thought was that I had missed, when he slumped down dead. And Dan and Osa slapped me on the back, telling me what a marvelous shot I was.

Another prize

But the big event of the day was to come. When nearing camp, I saw three pigs away off on the horizon, clearly outlined on the top of a small hill. I don't know how far away they were, but I do know they could not have been less than five hundred yards, and a pig is a pretty small object at that distance. A couple of wart hogs were needed for one of the groups. I had the car stopped, stepped out, and without taking careful aim, I fired. It was only a gesture for I was still sore at the world. Even at that distance we could see the pig tumble over. Going up, we found him stone dead.

That was a pretty good day, three animals with three cartridges. I was feeling all puffed up when I returned to camp, especially when Dan made the most of it in the telling, but I was mighty careful from then on that I did no more shooting before an audience. I had a reputation in camp and I meant to keep it.

A halt in work

By now Carl was a pretty sick man and it was decided that it would be best to send him into Nairobi, so one of my best and most comfortable trucks was bedded down for him, a place where Mary would be comfortable was made, and with John Wilchusen, our expert mechanic from the Willys-Knight factory, driving, he was taken into Nairobi to a nursing home, while the rest of us remained behind. Dan took it upon himself to get the remaining animals for the groups, then we all went into Nairobi. We found Carl much better, but still in the hospital.

We now scattered in different directions. Dan went down to Tanganyika where he secured the Greater Koodoo Group. He made another safari to the Kinna River country on the edge of the Kaisoot desert and finished the Lesser Koodoo Group. Mr. Eastman went up to Mount Kenya after elephant, but was not

successful in getting a big one. He could have shot medium and small elephants, but he wanted a big fellow. Osa and I went back to Lake Paradise, and shortly afterward Carl left the hospital, and with Mary and Mr. Derscheid and Mr. Raddatz and Mr. Leigh went to Mt. Mikeno to secure the accessories and the paintings for the Gorilla Group, and to finish the plans for the Parc National Albert.

There is no need of my going into details as to what happened there, for I am sure that everyone interested in Africa and the American Museum of Natural History, knows of the tragic death of Carl Akeley, but one thing I would like to speak of.

An appropriate resting place

One day, before Carl took sick, he and I were talking of the gorilla country. By this time Osa and I had covered most of East Africa, and Carl was telling me of the photographic opportunities of the Congo. He told me of the adventures he had while with Mr. and Mrs. Herbert Bradley when they secured the Gorilla Group. He went into detail about the beautiful spot where he had been sitting when he saw his first gorilla, and in a dreamy way he said that when he died, he would like to be buried at that very spot. So it was a strange coincidence that he should be taken sick and that he died at almost the very spot he had told me about some months before, and was buried at this place, in the country he loved so well, among the gorillas that he had worked so hard to save from extermination.

Mr. Eastman returned to America, Dan Pomeroy returned a few months later, while Osa and I remained on a few months to complete "Simba." Then we, too, returned to New York. We saw the African Hall start to materialize, but our hearts were in Africa. Osa and I did not remain long in America. Soon we were back in Africa, this time with Mr. Eastman on the Nile and in the Congo and in Uganda, where he secured his white rhino and his elephant.

The elephant presents a special set of problems to the camera hunter. He sleeps through the day and eats in the cool of the evening and night. We have spent weary weeks following various small herds before we could catch them under light conditions that would permit the making of satisfactory pictures. And there is always the possibility that if you get too close

you will spend more time getting out of their way than you will taking pictures.

Then we returned to America again, and the African Hall was moving along slowly. Again we returned to Africa, this time to film "Congorilla" and to visit Carl's grave on Mikeno.

With us was DeWitt Sage, who climbed Mikeno with us. We heard from the pygmies that the gorillas were now on the opposite side of the mountain from where Carl was buried, so it was some weeks before we finished our work with this group of gorillas and safaried over the mountains to Carl's grave, up and down hills and valleys at an altitude around 12,000 feet all the time. Almost exhausted we arrived in the saddle of Mikeno late in the afternoon, with a cold, drizzling rain sweeping through the valley. Osa, DeWitt and I went directly to Carl's grave before making any preparations for camp. Briefly we paid our respects to the sleeping Carl, one of the best friends we ever had. His grave was in remarkably good condition, covered with a cement slab, his name and date of his death engraved over the head, surrounded by a high log stockade to preserve it from the buffalo in the vicinity.

An unhappy beginning

Here we built camp alongside the grave, and spent a miserable night. The ground was soaked with rain, cold fog drifted into the tent; we could not sleep warm because our bedding was wet, and we did not have enough blankets; but outside our porters were in worse shape than we were, they had no tents. They just rolled up in their soaking blankets and went to sleep. I expected to have a lot of sick natives on my hands next day, but they were used to such hardships and not one even showed a sign of cold when we arose next morning with the sun shining clear and bright.

Then we examined the grave again and found that Raddatz had done an excellent job when making it. The large slab covering it was in perfect form without a single crack, and the inscription was as clear and legible as the day it was placed there. It was evident that Mary had selected the best location to be found, as the drainage was perfect.

During the following days Osa made minor repairs to the stockade and planted evergreen

flowers around the slab, while DeWitt and I explored the surrounding country.

Patience rewarded

The first place I now wanted to visit was the spot that Carl had told me about, the spot where he had first seen gorillas, and the place he had described as the most beautiful view he had ever seen. Magollo, Carl's old guide, knew the exact spot and took us there. It was only a stone's throw from his grave. When DeWitt and I reached the spot, it seemed anything but beautiful. The cold, damp fog rolled over the country so that we could see nothing a few feet away, but we decided to linger in the hope that the weather would clear. We built a fire, and determined to wait for a rift in the clouds. Intermittently the sky would reveal itself for a minute or two, then disappear. Patience is a virtue, they say, and in this instance we were bountifully rewarded for our three hours' vigil. Clouds and fog were peeled off the mountain-side. The sun broke through, glorious and clear. We could see for fifty miles or more. Active volcanoes sent thin streamers of smoke into the air. Beyond were rolling mountain ranges. We could see Lake Kivu in the distance, and alongside it a range of mountains to the west which our guides reported were the habitat of gorillas. The scene unrolled before our enraptured gaze was a magnificent panorama, noble, majestic, and overpowering in its effect—a fitting canopy for the final resting place of Carl Akeley, who was its discoverer for the world of white men.

Now that I think it over, I agree with Carl as to the wild beauty of this place, and I will always think that Mr. Leigh's striking paintings that form the background for the Gorilla Group, have captured Africa as it has never been done before.

As I write this, Osa and I are aboard a steamer in the Red Sea on our way to Borneo. Three weeks ago we spent several hours going through the nearly completed African Hall, and we marveled at the wonder of it all. To us it is the finest thing ever done of its kind. We stood in front of the Gorilla Group and again saw that wonderful view from Mikenno. We forgot the hardships and the mist and rain and cold. We saw only that marvelous view with the Gorilla Group mounted into the scene, so real and so colorful. That group is a masterpiece.

Then we moved to the Water Hole Group near Archer's Post on the Northern Guaso Nyiro River. We have camped in at least half a dozen places in the distance in that very scene. It is perfect in its makeup—the water hole itself, the mountains in the distance, the Dom palms scattered between the river and the water hole. Some, who do not know Africa, will think the colorings are exaggerated, but we know they are not. We have visited this place at least a dozen times during the past sixteen years and know the scene as reproduced in the American Museum is perfect in every detail.

The Plains Group

Then we moved to the Serengetti Plains Group. Here again is perfection. Thousands of animals to be seen in the distance are just as you would see them if you went to that spot right now. And we recalled the day we had stopped and looked over the plains and then back to Mr. Leigh as he was painting back of us. We pointed out to each other the places where we had camped during the past sixteen years. Every detail was perfection, and there in the group was the big wildebeest I had shot while with Osa and Dan; and the Grant's gazelle.

Then we were in front of the Impalla Group that Osa and Dan had worked on so hard in order to get the animals of just the right size. I was not along when they secured this group, but every mounted animal meant an adventure to Osa.

And there was Dan's Greater Koodoo Group. Neither Osa nor I were along when he secured the Koodoo, but Dan had told us of his trials and hardships in getting these beautiful animals. We met in Nairobi at dinner the night Dan returned from Tanganyika, and heard his thrilling story of getting them in that hot, rocky, semi-desert down near Dudoma.

We were not along when Mr. Eastman secured the Buffalo Group at Embu, but we know that buffalo swamp well, and know it is true to life—the cow herons on the backs of the buffalo and scattered about in the swamp, snowclad Mt. Kenya in the background, the hills in the middle distance, all just as they should be and all marvelous in their perfection.

The bongo and the giant forest hog among the dense bamboo forests—why, we could almost feel that we were there again, especially Osa who has spent much time up there

hunting bongo and fishing for trout in the clear mountain streams.

Realization

It's a wonderful hall, that African Hall. Surely if Carl could see it today he would not be able to find a flaw, and how proud he would be that his dream had come true, and that the people of America could see Africa exactly as it is—Africa that will some day disappear as civilization marches in.

Osa and I feel proud that we have had a small part in making Carl's dream come true. The elephant herd in the center of the Hall was not completed when we left America, but we can visualize it from the drawings and small models. Mr. and Mrs. Davison spent months in getting the four elephants to add to the four that Carl secured and mounted before

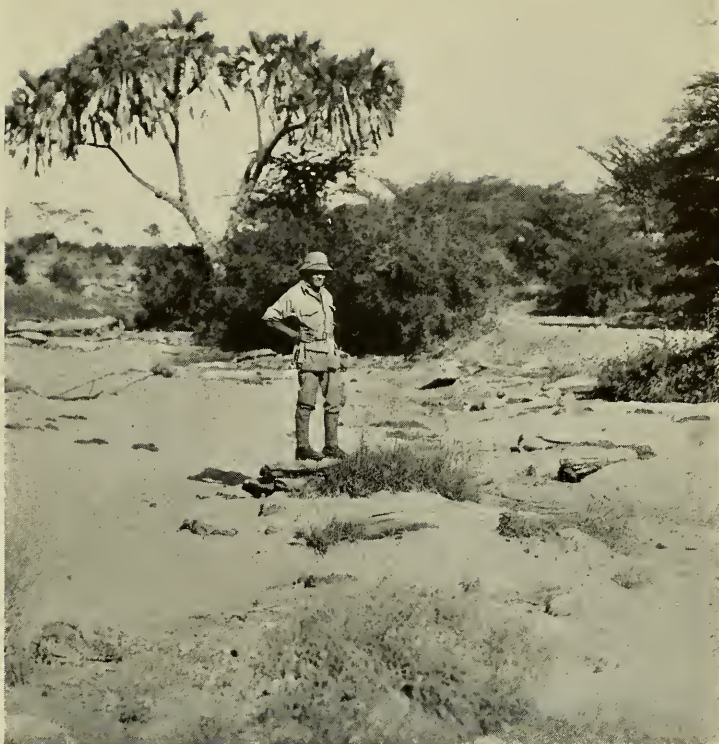
he died. We were with the Davisons when they shot the elephants on the Tana River in East Africa—every elephant an adventure. What a thrill for them when they see their herd combined with Carl's!

The men behind the Akeley Hall

It was the late Henry Fairfield Osborn, for twenty-five years president of the American Museum, who saw Carl's dream start and helped work it out. It was the energy and enthusiasm of Dan Pomeroy who pushed the Hall through from beginning to end; President F. Trubee Davison whose interest kept the idea going; James L. Clark and his staff of taxidermists who have supplied the last word in mounting; the staff of painters who have reproduced the African scenery so truthfully.



(Right) Carl Akeley surveying the water hole which was chosen as ideal for reproduction in the American Museum group



(Below) The personnel of the Eastman-Pomeroy-Akeley African Expedition





(Above) Mr. Akeley changing a film pack in the field



(Left) Mr. Eastman with a native porter in Tanganyika

(Opposite page) Upper picture—Mr. and Mrs. Akeley with a group of Lumbwa natives

Lower picture—Messrs. Leigh and Jansson, artists, showing the sketch for a group background to Messrs. Pomeroy and Eastman





The giraffe—a creature that makes a fantastic picture on the African landscape. These were photographed on the Serengeti Plains, where game in countless numbers quietly grazed

The most difficult type of picture to obtain is one showing wild animals in an undisturbed and natural state. The photographer has not only to consider the usual problems of light, shadows, and composition





A water hole is an ideal spot for a photographer of wild life to catch his game. A giant eland may be seen above in the center foreground, with several oryx and zebra near by

ut has to work without letting the alert creatures know of his presence by sight, sound, or smell. The picture below of a herd of Grant's gazelle is well worth such effort

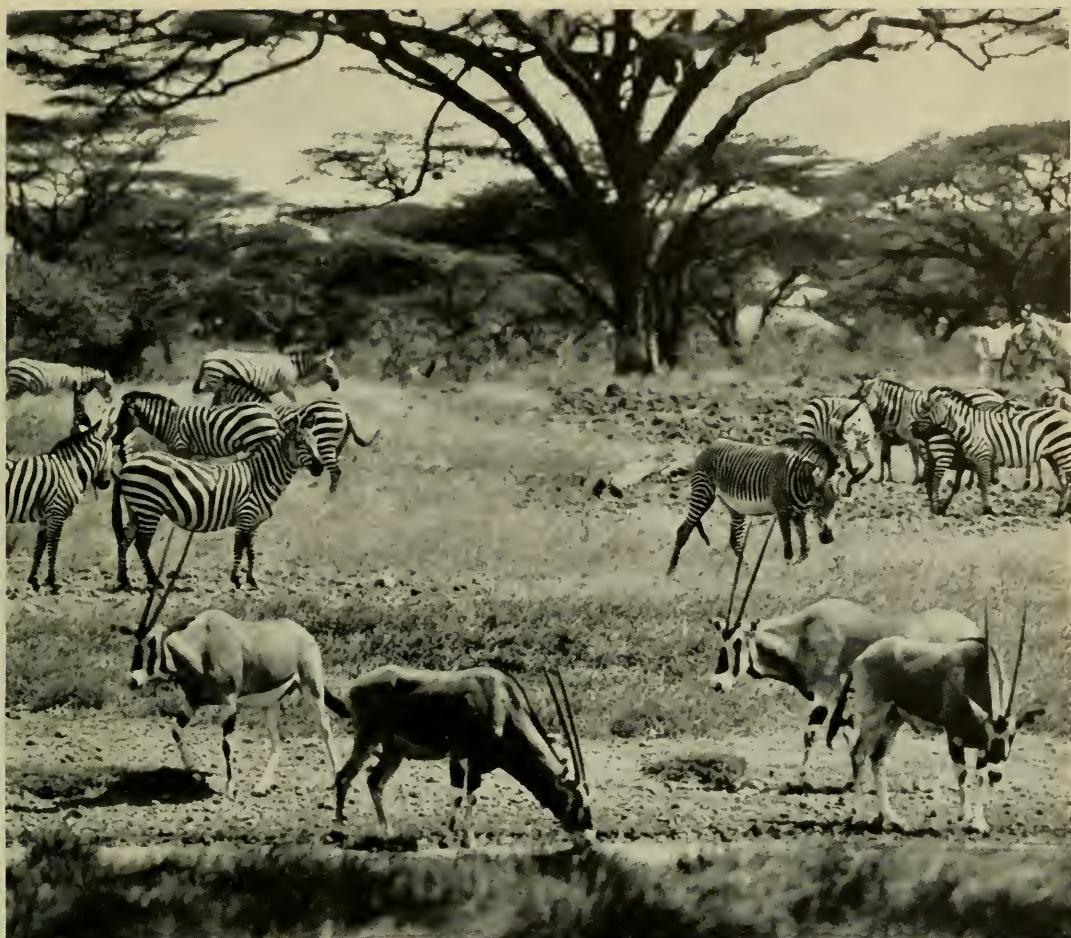


(Right) Camp of the Eastman-Pomero-roy-Akeley African Expedition combined with the Johnson party at Tanganyika



(Below) A leopard which made a flash-light picture of itself (in coöperation with Mr. Johnson) at Lake Paradise





(Above) A typical assemblage in the search for water—oryx and zebra at Chobe water hole

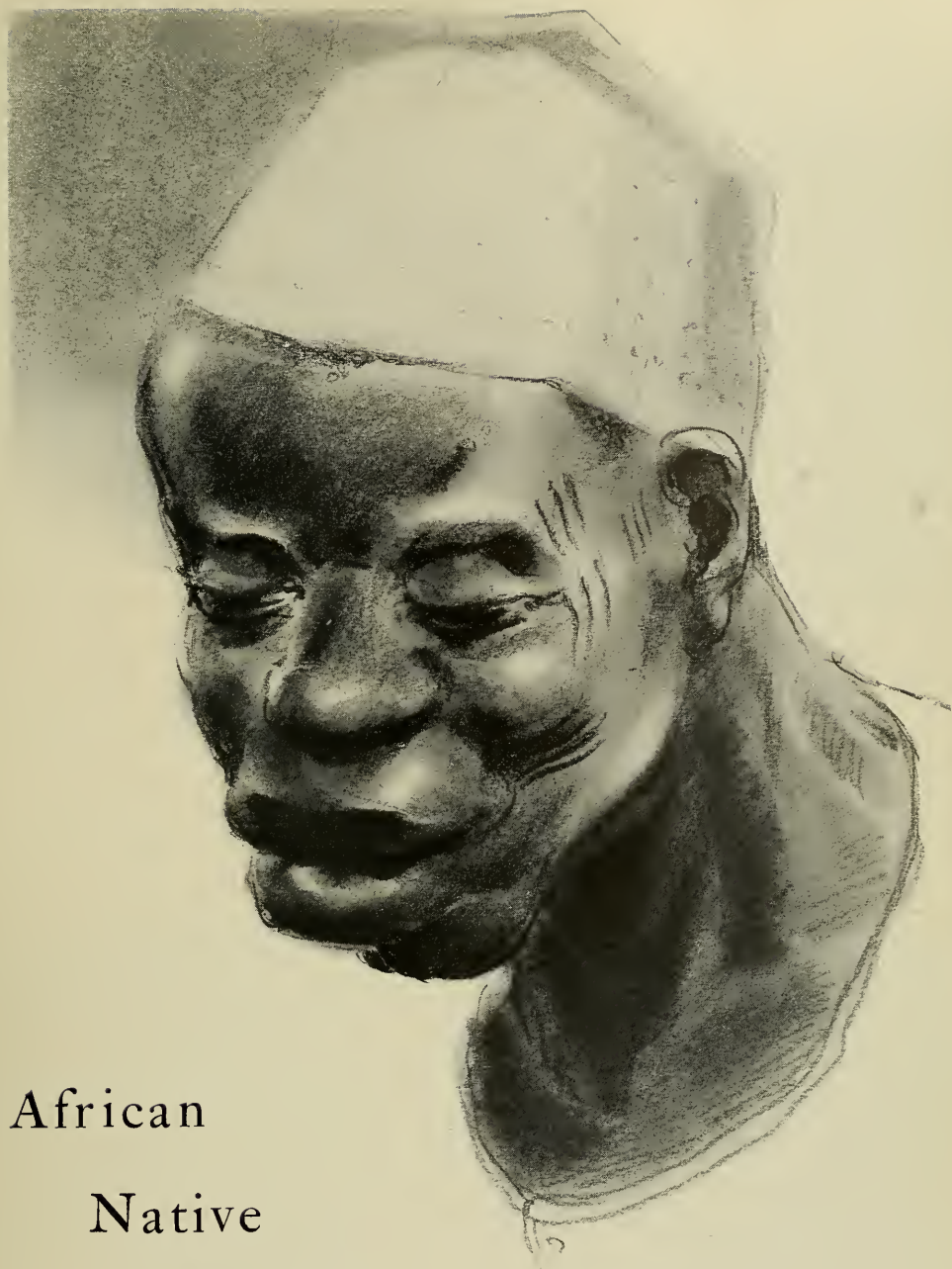


(Right) A group of wild dogs apparently entirely unaware of their proximity to a camera



Carl Akeley's final resting place on the slopes of Mt. Mikenno, in the gorilla country he loved so well. (Above) Mr. and Mrs. Johnson at the end of their pilgrimage to pay tribute to the memory of their departed friend

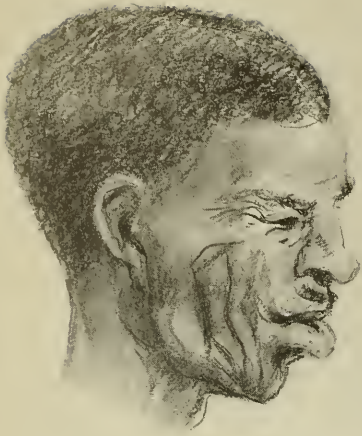




African Native Types

*A series of drawings by Carl
N. Werntz, President, Chi-
cago Academy of Fine Arts*

*A Hausa merchant, from Lagos,
Nigeria. He offers for sale in-
tricately stitched leather novelties,
all the while blissfully unconscious
of the similarity of their design to
the pattern on his own tattooed skin*



(Above) The artist sketched this individual because his facial angle was so like that of the wax Bushmen in the Cape Town Museum



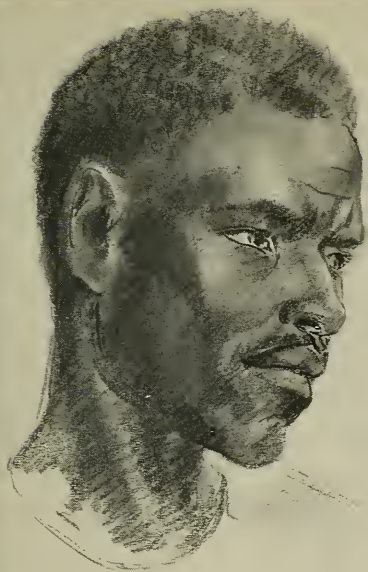
(Above) "Nona"—escaping some of her race's cranial distortion—is a true Hottentot woman, rather pretty in bright print dresses fashioned after an ancestral "Missie's" wardrobe

(Below) This old Wamanyama woman dancer of Mombasa has crowded every possible decoration into her headgear and painted her face white to celebrate the end of Ramadan

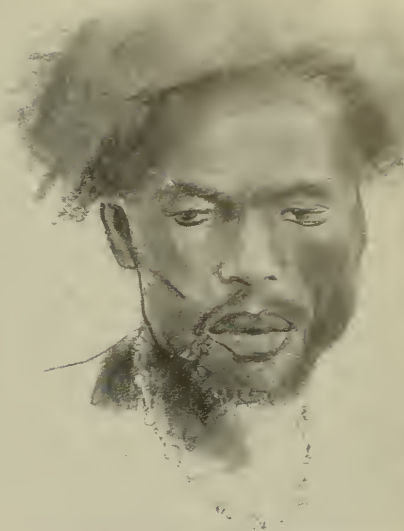


(Below) The Abakota market woman of Lagos wears a typical headdress without which she would suffer loss of trade



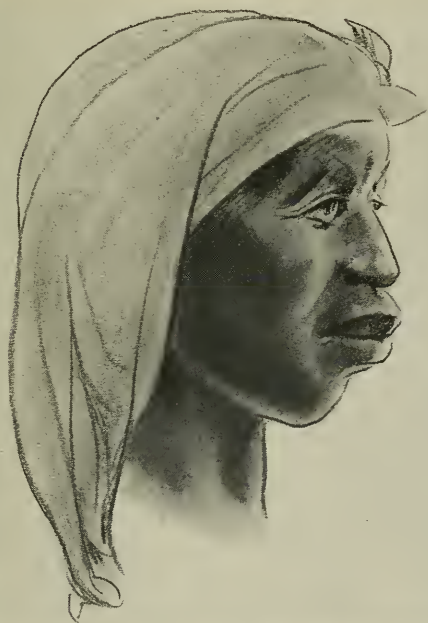


(Above) "Mwemba" a member of the Mtoka Tribe, Northern Rhodesia. He was adopted in infancy and raised to manhood by Hottentots. He is now an intelligent garage worker



(Above) Pholongwane Magugula is a warrior in the krall of the Paramount Chief, Swaziland. Occasionally he writes poetic war chants

(Below) A Chimondo girl from Hana del Norte, many miles inland from Portuguese West Africa's coast. She works at collecting coconuts for a Garden of Eden oil mill

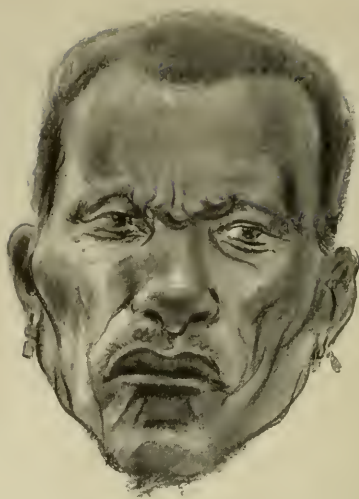


(Below) Ntitobhi—a Swazi "princess," sister of the Paramount Chief. She was the only member of that "royal" family who was willing to sit for a portrait



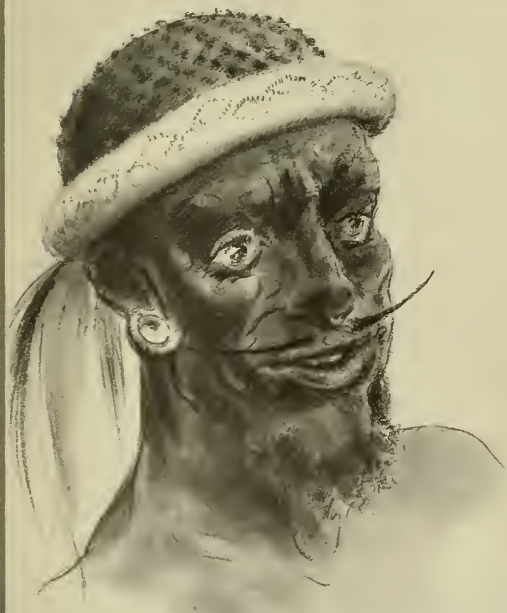


(Above) Eshowe, a Zulu girl, decorated with beads strung on her own hair grown long for the purpose. The beads are European, the craft African. Eshowe writes her love letters also in beadwork

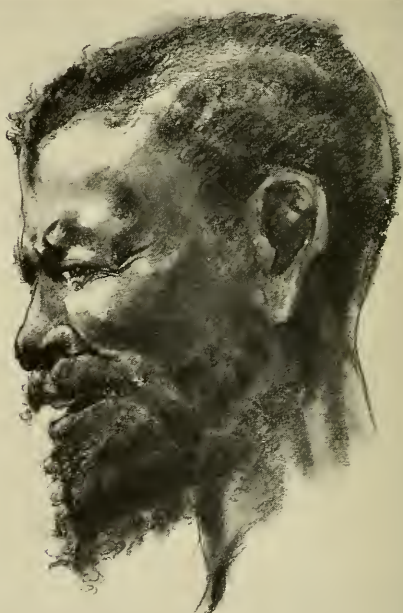


(Above) Jafuta, Matabele Induna. Intelligent, soft voiced, and deeply concerned for the depleted food supply of his people, he was found miles out in the trackless bush south of Victoria Falls

(Below) Ready for a celebration is this Zulu headman, whose ceremonial feather headdress and waxed moustache proclaim him a dandy



(Below) Sobhusa, Paramount Chief (hereditary "king") was reluctant to pose because he was not dressed in official silk hat and frock coat





(Above) *Induna Dhlamini. The official position of this Swazi Paramount Chief adviser is indicated by the feathers in his hair which were selected for the purpose with the most painstaking care*



(Above) *This Hottentot sketched in Walvis Bay—a town not quite registering as either land or water—readily admitting his race, claimed the name of “Joseph,” but when pressed, acknowledged he really was “Gachab”*

(Below) *A Fula merchant of Accra, British Gold Coast, bears a close resemblance to his Moroccan brothers across the Atlas*



(Below) *Proud of his office is Police Sergeant “Mciniseli,” a trim government employee in Manzini, Bremersdorf, Swaziland*





A NATIVE ARTIST

This Kubindo sculptor in Luanda, Portuguese West Africa, like any artist, loved his creations. Though glad to sell

for civilization's modern exchange, his natural recompense came by finding others who liked his birds of carved wood

The Image of Africa

Africa and its beauty—mysterious jungles, rolling plains, strange trees and flowers, roaming animals—invite the visitor to the American Museum to explore at his leisure

By JAMES LIPPITT CLARK

*Director of Arts, Preparation and Installation,
American Museum*

BEHIND the scenes of a great institution like ours there lies another little world, quite different from what our visitors suspect when passing through our quiet, spacious halls, viewing scenes from other lands so real they quite forget they're in a museum.

Back of these closed doors our little world just buzzes with its infinite interest and manifold activities of management, research, and exhibition.

Little, too, does our visitor suspect that from our Museum building pour forth each evening more than five hundred men and women who serve our institution in one way or another throughout the year.

Highly specialized units

Around each activity are grouped individuals especially selected to serve that particular branch in some way or other. Not least of these multiples of highly specialized units is the department of arts, preparation and installation, a group of artists, craftsmen, technicians and assistants, who, in coördination, create, besides many other things, those colorful exhibits of animals in nature, those scenes which are truly works of art, like great paintings in three dimensions.

Such exhibits fill African Hall. Akeley did much, through his development of technique, to make possible such exquisite pieces of work. Without his tireless hours of work and research, he never would have developed the

sculpturing method of setting up animals, instead of "stuffing" them; nor would he have developed that ingenious and highly technical method which makes it possible for us now to undertake a whole herd of elephants as the centerpiece for African Hall. Elephants before were a bugaboo to taxidermists and museum directors alike, for they implied such seemingly insurmountable difficulties that they were only very occasionally attempted by some courageous soul or some ambitious one who, ignorant of the difficulties, went headlong to disaster. And that is why so few are now to be seen on exhibition.

Progressive ideas

These improved methods, with the artistic ability of the various members of the preparation staff, have alone made possible those wonderfully lifelike animals now to be seen in African Hall, while other progressive ideas, in the construction of groups and group cases and details attendant upon them, all laid the foundation for the very successful culmination of this beautiful hall.

My association with Akeley began in 1902, when, coming to this Museum purely as an animal sculptor, I became acquainted with him while he was still associated with the Field Museum. He became interested in my work, and after a time divulged to me all the secrets of his new methods. He told me he looked to me to "carry on," and from then until his death we worked side by side, in Africa, in the Museum, in the development of his camera, and in the planning of this great hall.

He died when on the threshold of the realization of his greatest dream, and it fell to his

associates to carry on. To me came the part of organizing the staff for creating the groups themselves and guiding the artistic phases of these and the hall. Akeley had constructed a small architect's model of his proposed hall. This, on a scale of one inch to one foot, showed the main and mezzanine floors, with spaces for sixteen groups to a floor and his four elephants in the center.

In this, one or two little sketch models of groups suggested what might be the treatment of the others. Obviously, as there were so many kinds of animals in Africa, the difficulty was not what to put in, but what to leave out. Opportunities, too, would often govern the selection and securing of a group, so Akeley went to Africa on his first trip with an open mind.

As a result of this first African Hall Expedition—the Eastman-Pomeroy-Akeley African Expedition—several groups were collected, and upon my return from the Morden-Clark Asiatic Expedition, I was asked to take full charge of this work and organize a staff to cope with the very pretentious program ahead of us.

No such thing had ever been attempted before, either in quality or scope, and there were no precedents to guide us. Ways and means had to be found for the first time, problems had to be overcome as they arose, and methods invented to meet new demands.

A staff organized

First of all was the building up of a staff, which eventually totalled some forty-five, all directly or indirectly on African Hall. With outstanding co-workers like Mr. Albert E. Butler, my associate chief, Mr. W. R. Leigh, as master background-artist, assisted by Dudley Blakely, Messrs. R. H. Rockwell and John W. Hope as the leading animal sculptors, and Messrs. U. Narahara, G. E. Petersen, G. F. Mason, J. P. Guerry on the flora and foregrounds, and a score of other hand-picked artists and craftsmen, we began to move forward in the building of these exhibits.

Now that we had started, questions and problems not previously anticipated began to arise, while, for the time, at least, no answers could be found. Things were dependent upon one another, and the only way to solve them was to build a larger miniature model of the hall, wherein we could work out these prob-

lems and at the same time develop the ensemble of groups and hall.

This we did, scaling it two inches to one foot, which was large enough to develop our plans. From architects' blue prints of the building itself we built this model, setting structural columns and other fixed features in their proper places and then developing the interior treatment of case fronts and group spaces.

The group in miniature

When the structural and architectural problems were solved, we concentrated on the groups themselves, the animals to be shown, the type of country and its flora. From a mental picture based on our personal experience and data at hand, we began constructing our little groups, also in miniature. Little animals were modeled and painted, little trees and little rocks made, and then all assembled in our little group, behind which the artist painted a scene of the African veldt or jungle forests. All was arranged to tell the story of how and where these animals lived, and changes were made to perfect the composition, both in form and color. It was like a little doll's house—placing each little piece of furniture so as to develop the best decorative treatment of that little room.

Several groups were carried on at one time, purposely, so that we might, while making them, get them as varied as possible and show not only different animals, but totally different types of country and totally different plant life.

These were made in contrasting color tones, moods of nature, to give further variety. It was give and take here and there, until our little groups were well balanced by contrast and accepted as final. These then became our working models, our "blue prints," to guide us. Problems of construction, lighting, balance, technical difficulties, and many other lesser pitfalls were all solved in this miniature hall, and all of our uncertainties and experimenting were finally behind us.

We could now go forward. The background artist knew just what he was to paint; the animal sculptor knew just how to pose each animal; and the creators of the flora and foreground knew just what plants were to be made, how large they were to be, and where each was to go, so that it could be built to exactly fit the spot.

True, minor changes would be made as we

progressed, but only if they suggested themselves as improvements, but for the most part everything was closely adhered to. Otherwise, the careful planning in our little model would go for naught, and our group might flounder in hopeless confusion, far beyond ever bringing it back into a coördinated unit of artistic composition.

Opportunities in the field

None of this could have been accomplished so successfully of course, had not most of those working on it been to the field and seen Africa. There is no way of imparting to a creator of an artistic unit those subtleties which give that finesse that differentiates the ordinary from the exquisite. Such things must be felt, must be absorbed and assimilated, and then in turn, with understanding and enthusiasm, given out by the creator.

In so much as he has had the opportunity to see the beautiful and the power of feeling it, just so much will he give out in the expression of his work. Whatever success African Hall may enjoy, therefore, is due to the careful selection of our personnel and the opportunities they have had in going to the field.

The successful creation of a group or a hall does not begin behind the closed doors of the laboratory or office, but has its conception from a knowledge of the field condition. Akeley would never have dreamed his hall, had he not been to Africa several times and had its beauty and wonders indelibly impressed upon his mind.

So with the unit of a group—its first conception must come from experience in the field, from someone's knowledge, based upon what he has seen. Animals, plants, and material cannot be taken without a plan, an idea, of what the unit is going to be. Therefore, our groups are very often conceived in the very lair of the animals.

And with the animals—a successful group begins with the careful selection of the individual animals through the field glasses, even before they are shot. Then follows the painstaking and intelligent preserving of the valuable skins, that they may arrive at their destination without damage.

This is also true of the plant life, first selected for the part it plays in the animal's life or what its presence may indicate to the botanists or the geologists. Each unit selected should have some significance in relation to all others in the group.

In this way our groups gain in educational value. Even in the case of the background, it is not just a scene. It is a painting of a very definite spot in Africa, selected because it not only is the place where the animals were taken, but because it typifies the characteristic country in which they are to be found.

And so it goes—ever back to that intimate study of nature, before we dare make a selection, or even a decision. Much of the creative side is over when the material reaches the Museum. From then on, the technical side is foremost, wherein much labor and patience are involved.

True, not all the creative work is done, for now we must recreate what we have torn down in the field in order to bring it back. Now we have but the flat, dirty, and ugly-looking skin of the animal and a greasy lot of bones. We have none of the style, posture, or rounded conformation of his beautiful body. We have none of those veins and tendons and ripples of the muscles or the flash of the eye or pitch of the head. All looks hopeless.

"How can you ever make anything out of that mess?" says our visitor.

Those old dry bushes with dead leaves; and old tin cans full of dirt; bundles of stuff that looks like hay; pieces of old rock; some logs and an old tree stump—they all look headed for the ash heap.

Re-creation

Well, that is exactly what the department of arts, preparation and installation does—recreates those lovely groups from a "mess" like that. That is the material side. The art comes from elsewhere, from what we have seen, from what we have absorbed, from what we have felt.

Now the animal sculptor begins his clay model of the animal. From measurements, photographs and studies, he places the skull and leg bones of the animal on a frame and piles on clay until he has an anatomical study of the animal without the skin, the clay going over the bones where the muscles came off. While he carefully sculpts the contours, the tannery is at work preparing the valuable skin, which, in a relaxed condition, is frequently thrown over the model to check the fit and posture of the animal.

When all is satisfactory, a plaster mold is made of this clay model, and in this mold is

constructed a thin, light shell of maché and wire screen or burlap. This shell, reinforced with wooden ribs and iron rods in the legs, is removed from the mold and assembled, and now carries its own weight.

The skin, now completely tanned into soft leather, is relaxed in a poison-water to prevent attacks by insects, and in this flexible condition is applied to the modeled form with an adhesive. It is arranged as one would fit a wet glove on the hand, adjusted here and there, until each part is properly placed over its final position. The seams are sewn together and then it is allowed to dry.

Carefully made glass eyes of proper color are inserted and the lids modeled softly over them, while the cartilages of the ears are entirely replaced with sheet-lead replicas.

When thoroughly dry, a good brushing and arranging of the hair, painting of the eyes, lips and nostrils, add the finishing touches which give that final effect of life. Hardly can one believe, turning to other old bones and skins still untouched, that such a lovely creature could be made of them.

As for the old logs and sticks and bundles of bark, these become trees, and upon them go green leaves, shapely and fresh, as if in nature, so lifelike that our visitor hardly suspects they are made of beeswax and cotton, sheet celluloid, or just colored crepe paper. Bushes, too, come to life, with a burst of gorgeous flowers, which only Solomon's bees could detect, "re-created" from that jarful of colorless and wilted, but preserved, bunches of seemingly nondescript vegetable matter.

Growth of the units

All is definite material—supplemented, of course, by pencil sketches and color notes, to supply those elements which have been fugitive. Tins of soil serve as samples for the ground, while bits of rock give the color and texture of the big ones too heavy to bring back home and which we have decided to recreate also. From our photographs we faithfully reconstruct replicas in wire screening which we cover with burlap and plaster and stipple with a sponge or brush, to give it the desired texture. From our sample, an artist carefully colors it so true that we ourselves cannot be sure which is which, unless we pick it up and feel the weight.

Clumps of old dead grasses, mosses and

lichens are rejuvenated in a bath of hot water, which swells them back to normalcy. Another bath in glycerine, water, and arsenic holds them against further shrinkage and possible attacks of hidden insects, while they are air-brushed with colors of selected hues.

True to the model

Unit by unit grows throughout the various corners of the studios, while in the hall itself, after group cases have been constructed of iron and plaster and have been surfaced with canvas, the artist paints the background.

Now he must follow our little model closely and not deviate, lest he disturb important features of our composition. All units have been so dovetailed in their careful placing that to disturb one now would involve changing all, and we have gone too far for any reconsideration.

Lights are installed, adjusted from above to enhance desired color tones or to cast sunlight and shade over animals or parts of our group. Units, like rocks or bushes or even an animal, are put in from time to time to establish the proper relations of color between foreground and background.

With all units complete—painting, animals, plants, trees, rocks, etc., which may take a period of from one to three years after all this material has been taken in the field—we finally give the group a "dress rehearsal," and assemble them all within the case.

It is only now that we may break faith with our little model and turn wholly to our group, for now we have it all together and can see in the big life-size unit how well our little model has worked out.

Factors sometimes change when enlarged to life-size form, and only now can we best judge whether a change here or there will improve the whole, or not. Seldom do we make any radical change, hardly more than moving something slightly, or transposing two lesser objects.

With the final arrangement approved, the groundwork is laid in and constructed around the major units now in place.

For this we use a framework of wood, covered with wire screen, burlap and plaster, much like the rocks, and give it texture and a surfacing with the natural sand or soil, as the case may be, while the colored clumps of grasses

and smaller bushes are incorporated in the ground as we proceed. Débris from the ground, broken sticks, dead leaves and blown grasses, a land-snail shell, a piece of an old horn from some departed denizen, are strewn about in careless manner, as the last finishing touches to our group.

A final once-over, arranging the direction of some blades of grass, slightly adjusting a light that it may put a sparkle in the eye of an animal, a shadow here or there—and the plate glass goes in place, not vertically, but on a slant, so that one standing in front of it may not see reflections.

One by one our groups grow into being and take their chosen place in large niches of the hall, for they are selected for those very places, to make the hall an ensemble equally as much as a setting for the group.

The Hope panels

Large bas-relief panels, beautifully modeled by Mr. John W. Hope, and finished in silver, adorn the darker areas of the case fronts above group openings. Silver, too, is the color note of the mezzanine group fronts. Its life and neutral color serve well the ensemble of the hall, and likewise the group.

The great centerpiece of African elephants will, of course, be the most outstanding and

awe-inspiring unit in the hall. As one enters from the Roosevelt Memorial, one sees before him a whole herd of these ponderous beasts. In no museum is there an exhibit to compare with it. Eight in all form the group, four originally mounted by Akeley, and four collected by President Davison and now being mounted by Mr. Robert H. Rockwell, of this department.

A herd of elephants in itself is an astounding and momentous piece of work to attempt, yet it is but a part of our African Hall program.

Life-size bronzes of African natives, by Malvina Hoffman and others, will stand between groups before the columns, while all is bathed in a diffused light emanating from indirect fixtures in the ceiling.

Jungle light

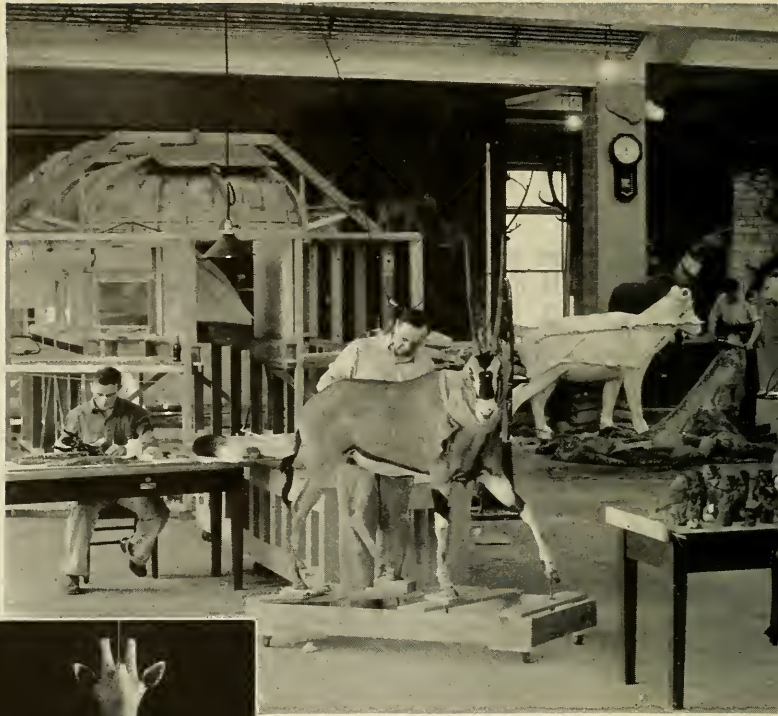
Upon entering the hall, one finds himself in the deep mysterious lighting of an African jungle. Not a single light opposes the eye, while the groups themselves stand out in a blaze of sunlight, as if one were looking through open windows across a torrid veldt.

Passing from one to another, our visitor sees Africa and its wonders—its roaming animals, its colorful flowers, strange trees and rolling plains and forest jungles. Transplanted Africa stands before him—a result of Akeley's dream.



One of the panels modeled by John W. Hope to go in the case front above the groups. This panel adorns the Giant Eland Group.

(Below) Mr. R. H. Rockwell giving the finishing touches to the clay model of the large giraffe for the Water Hole Group



(Above) Activity in the top sky-lighted studio of the Museum. Most of the animals shown here are in the Hall groups. In the right foreground a preparation is to become part of the herd of eight elephants

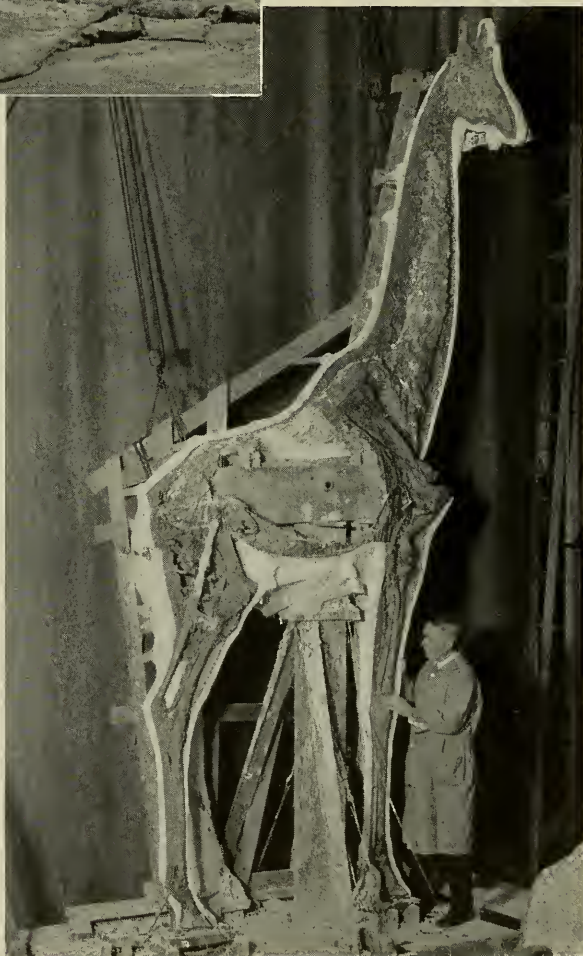
(Below) Detail study of the head of the large bull eland in the Giant Eland Group





(Below) One side of the three-piece plaster mold has been removed from the completed clay model of the giraffe

of the preparation department at the American various stages of creation are for the African ator is paring down an elephant's skin, which that forms the central exhibit of the Hall



(Below) Detail photographs of newly collected animals are a valuable aid





The foundation for mounting an animal is an armature constructed of wire mesh, burlap, or plaster, using the leg bones, skull, and any others that may be helpful in giving the proportions, action, and other characteristics of the individual specimen.

This armature is sufficiently flexible to permit change of action or position at any stage of making the model. Water clay is built up on the armature, using the field measurements as a guide to the accurate reproduction of the animal



RECREATING



When the clay model approaches completion, the skin is soaked and tried on. Any slight changes that may be found necessary are made after this fitting, and the skin given a final try-on before proceeding with the casting of the model, as shown in the photograph at the lower left.



A plaster mold is made in three pieces and reinforced on the outside, so that it can be removed from the model without breaking, and also make the building of the manikin more convenient

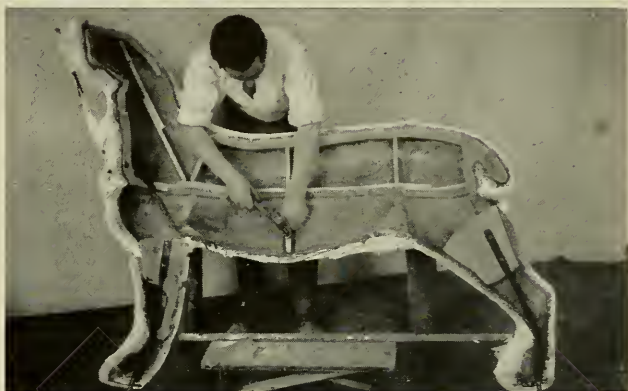
The manikin is built of burlap, wire mesh, and a very durable and hard-drying papier maché, reinforced inside with wood ribs cut to the body form and secured with maché. The burlap is first fitted into the form with glue, after the mold has been sized with glue. Thus, when the form is completed, it may be released from the mold by soaking the plaster with water. The three sections are joined after removal from the mold.

At this point the figure is an exact replica of the clay form

AN ANIMAL

The skin, which in the meantime has been tanned, is now applied to the modeled manikin with a special and enduring maché paste. Soft, slow-drying maché is used wherever necessary to bring out the delicate modeling of veins or wrinkles and details around the eyes, nose, and lips.

The glass eyes are fitted into position with great care after the skin is in place. Finally, with the waxing and coloring of fleshy parts, the mount is complete





(Above) The several plants shown here have been reconstructed in paper, wax, and celluloid by Mr. Narahara, who has had formalin-preserved specimens, photographs, and color notes, taken in the field, to guide him

(Right) A close-up photograph of a plant to guide the preparator in assembling the various fabricated parts



A form such as the ant hill shown at the left is too fragile to be shipped without breakage. However, with a few well-preserved samples for texture and with good photographs, the preparator can reproduce the form with impressive accuracy



(Left) This detail of a tree base almost engulfed in an ant hill has been reproduced in the Giant Eland Group

(Right) Trunks of large trees are seldom used in a group, but are modeled in maché over a form built of wood, wire mesh, plaster, and burlap. Photographs of the tree and samples of the bark are all that are needed by the preparator



(Below) Mr. Raddatz, a member of the Eastman-Pomeroy-Akeley African Expedition, is here shown making plaster molds of freshly selected leaves at the field base





In no other museum have whole halls been planned and carried out as a unit. Even while carpenters, iron-workers, and masons are con-

structing the cases, an artist is at work painting a background. Every available preparator is at work on some part of a group



A study of an African plant

The Water Hole Group

THERE has been an exceptional opportunity in each of the four corners of the Akeley Hall of African Mammals to build habitat groups of unusual size and depth. This has been especially effective in the portrayal of panoramas, mountain vistas, and great game herds. One of these larger exhibits is the Water Hole Group, representing a scene along the Guaso Nyiro River.

The water hole is to the animal life of Africa what the public square is to a town; it is the center of activity, the focal point of interest. At the water hole the various species come to drink and, social or solitary in disposition, mingle, perforce, with the other animals. Here the beasts of prey naturally find a favorable concentration of potential victims. The African water hole is one of the world's big spectacles of wild life.

In many parts of Africa, where a long, rainless season dries up small streams and practically eliminates available surface water, there will be local areas where the geological configuration provides a supply of water just under the surface of the ground. In such a spot a well or a natural depression will yield water in an otherwise semi-desert environment. Furthermore, this particular spot may afford the only water for a district a great many square miles in extent. Frequently the mammals dig out

their own depression, when Nature has not provided one, and when the soil is soft, a series of water holes may be established.

The giraffe (the subspecies shown is the reticulated giraffe, *Giraffa camelopardalis reticulata*), in comparison with other mammals, seems to be a misfit, a caricature of the normally proportioned animal. At the water hole the long forelegs seem especially awkward, for the giraffe cannot get its head down to the ground level, much less to a depression below, without spreading the forefeet wide apart, and it is fortunate that its neck is so long.

There are a great many varieties of African gazelles but the Grant gazelle (*Gazella granti*) is one of the best known and most easily recognized. It is the largest of the African gazelles and there are quite a few sub-species or geographical races, the one shown in the group being *Gazella granti raineyi*.

Most of the gazelles are plains or open country antelope, preferring the wide, open spaces to the forested areas. A few species work upward into broken country, follow valleys up into the mountains, or find congenial environment on an elevated plateau. The Grant gazelle wanders with the great assemblage of game that roams upon plains more or less well-grassed, with thorn scrub and occasional sparse forest growth.







GIFT OF MR. GEORGE EASTMAN.

ANIMALS by Robert H. Rockwell, John W. Hope, and Louis Jonas.

BACKGROUND by Wm. R. Leigh.

FLORA AND FOREGROUND by Albert E.

Butler, assisted by George F. Mason, Joseph M. Guerry, and Carlton McKinley.

BIRDS by Raymond B. Potter.

DIRECTION, James L. Clark.

SCIENTIFIC DIRECTION, H. E. Anthony.



The cross-hatching indicates the site of the Group

As is true of so many plains antelopes, the Grant gazelle relies upon its fleetness of foot to escape from its enemies. All its senses are keen, its power of vision being especially good, and it does not attempt to hide or to seek cover. Since there is so little cover which would hide a gazelle in most of the country frequented by these animals, the ability to keep well in the open from a predatory animal is the all-important factor.

The beisa shown about the water hole are of close kin to the gemsbok, the oryx featuring another group in the African Hall. The particular subspecies in the water hole group is *Oryx beisa annectens*, a variety ranging from the Tana River to the border of Abyssinia.



Beisa show a preference for dry plains where they can feed in open stretches of grassland. They may also be noted in areas dotted with low, thorny scrub. They travel in bands of as many as fifty individuals, but more often are seen in small groups. A herd is controlled by an aggressive old bull which keeps less powerful males out of the company until such time as a newcomer is able to drive him out to wander alone or with another outcast like himself.

Not only do the mature males fight actively among themselves, but they are not slow in turning their long, sharp horns against other species. In this reliance upon their natural weapons, both sexes compel respect from the other mammals, and a wounded beisa must be approached very cautiously and with the expectation of a charge.

In most of its behavior the beisa conforms to the usual pattern of dry plains animals, most active morning, late afternoon, and night, relying upon good vision, powers of scent and speed for protection from enemies, and possessing an ability to lead a successful existence with very little water.

The Grevy zebra (*Dolichohippus grevyi*) may be used as a representative of the rather large group of African zebras, although it has certain anatomical characteristics which the specialist uses to set it apart from the other striped horses. To the layman there is an affinity of relationship denoted by the conspicuously striped pelage and the compact horselike build of the zebras which makes it easy to identify one of these animals at a glance.

The zebra is one of the favorite food animals for lions, but despite the inroads of predatory animals, the zebras occur in great numbers over a large part of Africa. The Grevy zebra is essentially a plains type, grazing on the dry grasslands and through districts where no heavy forest occurs. It ranges from south-eastern Abyssinia south to the Tana River. It usually travels in bands of from five or six to several hundred animals.

The Grevy zebra is much larger than the Grant zebra and has more stripes. The two species may be found, sometimes, in the same territory and even mingle in a common herd.

—H. E. ANTHONY

Future Plans for the

By F. TRUBEE DAVISON

President, American Museum

AFRICAN HALL, as it stands today, is a splendid memorial to Carl Akeley and a living testimony to the generosity of those who gave their time, thought, and funds to the realization of his magnificent vision.

Still, superb as it is, the Hall is but partly completed. Only half the number of groups which eventually will be housed in this latest and loveliest of all Museum halls, have been collected and installed.

Out of the total of twenty-eight groups that have been planned, fourteen are financed and only ten are really completed. The remainder, fully as interesting and important as those now provided for, await the sponsorship of those who would like to lend a hand in the effort to perpetuate within the protecting walls of the American Museum a cross section of the Africa which Akeley knew and which is rapidly disappearing.

It may be well at this time to give a brief outline of the habitat groups still unprovided for in the Museum's African Hall project. They include black rhino from Kenya, addax from the Sahara Desert, okapi from the rain-soaked forests of eastern Congo, mandrill monkeys from the coastal regions of West Africa and the spectacular Colobus monkey which is not only celebrated for its beautiful markings but also intensely interesting from a biological standpoint.

Among other interesting groups which we hope to create in the African Hall are the following:

A scavenger group which would show a typical African scene with the scavengers of the veldt, such as vultures, marabous, jackals, and hyenas converging upon the remnants of a lion kill.

A leopard group which would show one preparing to attack its prey—perhaps a red river hog. In that way we would show two animals—the leopard and the hog—in their natural setting. Pigs are a favorite prey of

A preliminary plan for the Lesser Koodoo Group, one of the miniature sketch models designed for the mezzanine of the Akeley African Hall



Akeley African Hall

leopards, and the red river hog is a very spectacular member of the pig family.

Although the ostrich is a bird naturally to be sought in a bird hall rather than in a hall devoted to mammals, still it seems proper to include one or two members of this interesting family in one of the groups. There are several reasons for this. The first is that the ostrich occupies a permanent place in the public mind in connection with Africa; and secondly, it is considered as big game by most people who travel in Africa. The picture we plan might, for instance, show a male bird with his head down and his wings spread, driving off a family of wart hogs which happens to be passing too close for comfort.

Of course, African Hall would not be complete without a group of chimpanzees showing how these great apes live in the treetops of the West African jungles. This group would give a vivid picture of their family life, the nests they build and the food they eat. It would afford an interesting comparison with the great Gorilla Group which is already completed.

Also to be mentioned is a cheetah group depicting this very interesting animal which has the appearance of a cat but has claws like a dog and is one of the fleetest animals alive. This beautiful creature is like a leopard, but has long legs, and the spots on its coat are a series of black dots instead of broken circles.

Others who have written articles on Africa and the Akeley Hall of African Mammals for this issue of *NATURAL HISTORY* have presented a far more detailed picture of the American Museum's aims and interests in this connection than it is possible for me to do, but I want to point out that in African Hall we strive to do much more than merely keep a record of the animals of Africa. Each group is not alone an exhibit of the type of animal it features, but it is a complete cross section of the region, which reveals the geology, botany, bird, and reptile life of the region. It goes so far as to cover even the meteorological features such as characteristic types of clouds.

When Akeley dreamed this hall, there were but very few who realized that it was possible

A miniature sketch model of the Klipspringer Group, one of the fourteen planned for the mezzanine of the Akeley African Hall

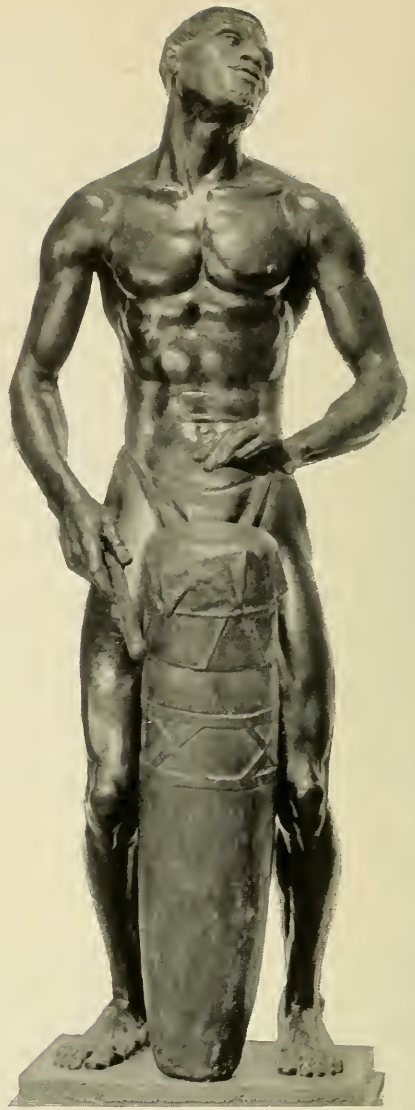


for the great herds of game to shrink and for the abundance of animal life to dwindle. Only a few men, like Akeley, seemed to realize that a large part of this animal life will eventually disappear and that something must be done to preserve their record. This was what stimulated him to dream this great hall and, now, his associates who appreciated his foresight begin to realize that the end Akeley predicted is not as remote as many people thought. In fact, in spite of drastic conservation measures, the magnificent game animals are being destroyed. It is not so much sportsmen who kill the game as it is the advancing wall of humanity as it expands over the surface of the globe and enters hitherto remote sections, looking for new and tillable lands. Unfortunately, big game and man cannot live together, and even National Parks in Africa, similar to those in the United States, do not eliminate problems in the saving of game within these protected areas.

Hand in hand with conservation goes the work of the American Museum of Natural History and similar institutions to preserve for posterity an accurate picture of Africa. All things change, even Africa. The "Dark Continent" of Stanley's day became the "Bright Africa" of Akeley's time. Probably the period is not remote when cities and plantations will

(Right) The bronze figure of a tom-tom drummer which will add a human element to the African Hall. It is the work of Malvina Hoffman and the gift of Mr. George D. Pratt

(Below) A miniature sketch model of the Black Rhino Group. These animals would have to be collected in East Africa

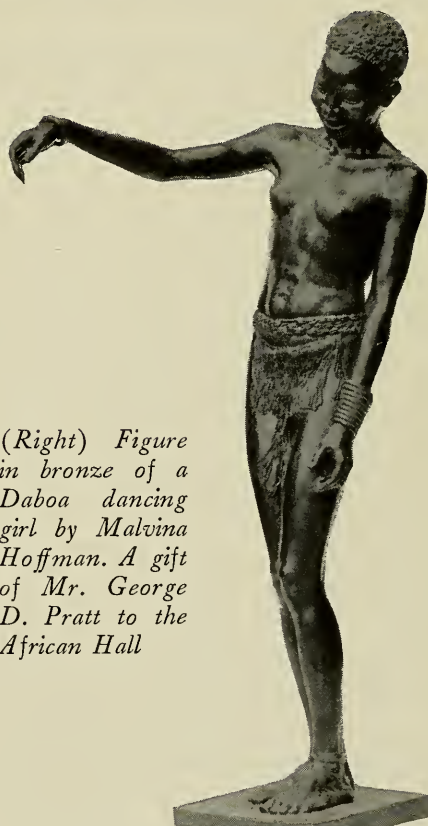




(Above) A miniature sketch model of the South African Group which would include specimens of springbok, wildebeest, and blesbok. All of these animals are now extremely rare and rigidly protected by law

conquer nature and primitive life on the veldt. The situation in Africa is somewhat like our own in this country. Years ago huge herds of buffalo and other game roamed the western plains. Today the herds are almost gone, and it is the advance of civilization that has destroyed them. The same is bound to happen to Africa, and that is why it is so important that our educational institutions make available for millions of people who never will see Africa, as well as for the generations that are to come, an accurate, beautiful, and instructive picture of African wild life, before it is too late.

I am proud to predict that the Akeley African Hall of the American Museum will be the finest of its kind—a memorial to a frontier that won the hearts of men such as Akeley, but the Hall is only partly complete as it stands today, and I sincerely hope that funds to finish this magnificent picture of an Africa that some day will exist no more will be forthcoming in the near future.



(Right) Figure in bronze of a Daboa dancing girl by Malvina Hoffman. A gift of Mr. George D. Pratt to the African Hall

Science in the Field and in the Laboratory

Expeditions, Astronomy, Education, Nature Trails, Fish, New Publications

Edited by A. KATHERINE BERGER

The Third Scarritt Expedition

The Third Scarritt Expedition of the American Museum of Natural History, sponsored by Mr. H. S. Scarritt and led by Dr. G. G. Simpson, worked for four months in central Montana last summer and the results are now being worked up at the Museum. With the assistance of Mr. A. C. Silberling, an able and well known local collector, two fossil quarries were opened and extensively worked, both at sites previously discovered by Mr. Silberling, and many other localities were examined. About 1,500 specimens of fossil mammals were discovered, of which 635 include considerable parts of skulls or jaws. Mr. and Mrs. Fenley Hunter of Flushing worked with the party during June, and Dr. Walter Granger and Mr. Albert Thomson, of the Museum staff, also worked in the field later in the summer. Mr. F. Trubee Davison, president of the Museum, and Mr. Scarritt also made shorter visits to the camp.

The summer's collection is one of the most important of early mammals ever made. It consists of remains of extinct animals that lived almost at the beginning of the Age of Mammals, some 50,000,000 years or more ago, and so casts light on many problems of the origin and early history of the mammals. The work of freeing the tiny and delicate fossils from the rock in which they were found is being done by Mr. Thomson, and will take many months. Until this is complete, it will be impossible to say exactly what is included in the collection, but from what has already been done it appears that about seventy-five species are probably represented, many of them new. Perhaps the most interesting of these are the primates, the oldest members of the group to which man himself belongs ever to be discovered anywhere, represented by many fine specimens in the new collection.

Most of the fossils collected in Patagonia, South

America, in 1933-34 by the Second Scarritt Expedition, have now been prepared and are being studied, and one, a fine skeleton of a new animal named *Scarrittia*, has been placed on exhibition.

Astronomy and the Hayden Planetarium

On Sunday January 5, the regular monthly change of program takes place in the Hayden Planetarium schedule, when the new lecture on the winter constellations will be given at the first afternoon lecture at two o'clock, and from then on during the entire month. This lecture will include a general discussion of constellation figures and mythology, dealing in particular and in detail with those of the winter skies. In addition to pointing out the figures of the constellations, the lecturers will tell the age-old stories connected with the various star groupings.

During the first two months in which the Hayden Planetarium has been open, more than 220,000 persons have attended the performances given there.

There will be a meeting of the Amateur Astronomers Association on Wednesday evening, January 15, at 8:15 o'clock, when Mr. James Stokley, director of the Fels Planetarium in Philadelphia, will speak on the subject "New Eyes to the Heavens." This will be an illustrated lecture, open free of charge to all those interested, and held in the large auditorium of the American Museum of Natural History, 77th Street and Central Park West.

Prize-winning posters

The thirty-eight prize winning posters, submitted by art students in the high schools of Greater New York in the Hayden Planetarium Poster Contest, have been placed on view in the Hayden Planetarium. In all, 351 posters of excellent quality were entered in the contest from twenty-eight schools in the five boroughs. The posters were judged by a group of well known artists—Mr.

Wallace Morgan, Mr. Lucian Bernhard, Mr. Thomas Benrimo, and Mr. Fred G. Cooper—who kindly served, together with members of the American Museum staff. The prizes, which were art materials attractively boxed in specially made blue boxes covered with silver stars, were generously donated by Binney & Smith. The prizes were presented by Doctor Sherwood in Education Hall on the afternoon of November 26.

Travel sketches

From December 24 to January 12 a series of travel sketches by Carl Wernitz entitled "Other Peoples, Other Places" will be on view in Education Hall.

Free motion pictures

The series of Saturday afternoon free educational motion pictures for 1936 will start on January 4 with the film "When Winter Comes." "Alexander Hamilton" will follow on January 11; "Animals—Wild and Not So Wild," on January 18; and "Fish Tales" on January 25. In February the pictures will be "Vincennes," "Bottom of the World," "Abraham Lincoln" on February 15, "George Washington" on February 22, and "Wolfe and Montcalm." This program will run until June 27.

Members' lectures

Dr. Wilfred Osgood of the Field Museum of Natural History will give the first of the spring lectures to Members on February 13. He will speak on "Ethiopians and Their Stronghold." On February 27, Mr. Arthur C. Pillsbury will give the second lecture in the series, "Growing Plants Without Soil." The course for children of Members will be opened on February 15 by Mr. Charles Crawford Gorst, speaking on birds and giving his fine imitations of their calls and songs.

Junior Science Clubs

In coöperation with the American Institute of the City of New York, the American Museum entertained the annual Science Congress of Junior Science Clubs of the American Institute on December 26 and 27. The American Institute arranged several special Christmas lectures in connection with the Congress, the speakers being: Commander Charles E. Rosendahl, Commanding Officer, U. S. Naval Air Station, Lakehurst, N. J.; Dr. E. C. MacDowell, Department of Genetics, Carnegie Institution; Dr. W. F. G. Swann, Director of the Bartol Research Foundation, Swarthmore, Pa.; Captain Albert W. Stevens, U. S. Army Air Corps, Flight Commander of 1935 Stratosphere Flight. The talks were broadcast from the Museum auditorium over WEAF.

Bear Mountain Nature Trails

The winter program of the Bear Mountain Trailside Museums and Nature Trails includes several new types of activities. Work is going forward on two relief models to be placed in the Trailside Historical Museum. The models will show the routes taken by British troops in the attacks upon near-by forts Clinton and Montgomery during the American Revolution. Excavation carried on, during the fall, in the West Redoubt of Fort Clinton, revealed valuable information that will aid in the construction of a miniature restoration of the ramparts.

A collection of sixteen species of local fish has been added to aquariums in the Zoological Museum. This exhibit is now housed in the Botanical Building. Fourteen species of small mammals, twenty-one reptiles, and many insects, crustaceans, and amphibians, all local, are on display at present.

The Orange County Science Teachers' Association meet at the Trailside Museum on alternate Sundays for the purpose of attending conducted hikes in the interior of the Bear Mountain-Hariman Section of the Palisades Interstate Park. These walks are designed to acquaint teachers with out-of-door facilities for nature study. Several iron mines have been visited and, in the near future, journeys will be made to beaver ponds and to other points of interest. The teachers are permitted to collect material for classroom use.

In connection with studies of the mammal life of the Hudson Highland area, carried on for the past nine years, nightly excursions by automobile are made into the interior of the park when weather permits. Powerful spotlights are used to aid in the observation of nocturnal animals. The problem of the distribution of white-tailed deer is of primary interest in this survey. It has been determined that many individual deer occupy approximately the same territory during the winter months. The record number of deer, observed in a single night along forty miles of highway, is sixty-two. In an attempt to encourage the animals to remove themselves from close proximity to the highways, three hundred pounds of salt have been distributed in the more remote sections of the Park.

—W. H. CARR

James Henry Breasted

Prehistoric archæology sustained a serious loss in the death, on December 2d, of Prof. James Henry Breasted of the University of Chicago.

Professor Breasted was not only a teacher of ancient history and of Egyptian and Oriental languages, but as director of the Oriental Institute he promoted archæological research in Egypt and the Near East on a larger scale probably than any other man. Naturally he was concerned chiefly with

the advanced cultures of early historic times; but, fortunately, his interest did not stop there. As proof of this he prefaced his textbook, *Ancient Times* (1916), with a brief but well balanced chapter on "Early Mankind in Europe." A few years later, in 1919, he presented a lengthy paper before the National Academy of Sciences in Washington, entitled *The Origins of Civilization*, in which among others things he sought to show that the Neolithic culture in Egypt dates back to about 18,000 B. C. His alleged facts, namely, the repeated occurrence of artifacts in the Nile Valley silts down to a depth of as much as eighty feet, so far as known have never been disputed; but they appear to be ignored by several recent writers, who would place the beginnings of the Egyptian Neolithic as late as 6000 B. C. In the meantime, however, Breasted directed an extended investigation in the Nile Valley and the adjacent Faiyum Basin, having for its object the correlation of Paleolithic implements with the prominent gravel terraces. The field work, carried out by K. S. Sandford and W. J. Arkell, two English geologists, was continued for a period of years and the valuable positive results have been published by the Oriental Institute in two sumptuous volumes.

In view of such accomplishments it is regrettable that Professor Breasted could not have lived long enough to have instituted a similar survey for the great valleys of Mesopotamia. However, as a result perhaps partly of his efforts, much intensive archaeological work has recently been carried out, particularly in Palestine; but whether this is so or not, prehistoric archaeology must forever be indebted to Professor Breasted, who saw man and his culture as a single phenomenon and who did much to clarify it.—N. C. N.

A Striped Marlin

The department of fishes of the American Museum has received the skeleton and fins of a striped marlin from Mr. Templeton Crocker who secured it at their request, on a recent trip to Lower California. Compared with similar material of the blue marlin already in the Museum collection,

this fish is seen to have a more slenderly tipped smoother spear, longer, more pointed lower jaw, straight versus curved pectoral fin, the front rays of the dorsal and anal fins less heavy and these fins less pointed. Its relationships are evidently with the Atlantic white marlin rather than with the blue or others of the black marlin group.—J. T. N.

Early European Civilization

The Library of the American Museum has received from the New York Academy of Sciences Luigi M. Ugolini's recent work entitled *Malta, Origini della Civiltà Mediterranea*. The volume is illustrated by 114 text figures, many beautiful full-page plates, and a map. It is an interesting and welcome addition to the Library's collections on early European civilization.

Appointment

Dr. J. Eric Hill has been appointed assistant curator of mammals at the American Museum to fill the vacancy created by the resignation of Dr. Robert T. Hatt. At the time that Doctor Hill was appointed he was engaged in the study of special mammal problems under Dr. Joseph Grinnell, director of the Museum of Vertebrate Zoology, University of California. Doctor Hill is a graduate of the University of Kansas of 1931. He has spent several summers in the field for the University of Kansas, as well as in California, Oregon and Manitoba, on his own account. Doctor Hill has published a note on a new amphibian from Kansas and several other short papers on rodent anatomy. A report on the pocket gophers of the Lower Colorado Valley will be published shortly in the Journal of Mammalogy as a joint article by Dr. Joseph Grinnell and Doctor Hill.

Recent Museum Publications

BULLETIN

Vol. LXVIII Art. VIII.—Results of the Archbold Expeditions. No. 7. Summary of the 1933-1934 Papuan Expedition. By Richard Archbold and A. L. Rand.

RECENTLY ELECTED MEMBERS

A REPORT from the membership department lists the following persons who have been elected members of the American Museum:

Patrons

Mrs. Harry Snyder
Miss Dorothy Jane Snyder
Messrs. William D. Campbell, Willard H. Carr, Dean Sage, Ernest Shoemaker.

Fellow

Mr. Charles T. Wilson

Life Members

Mrs. Alfred G. Kay
Dr. J. Warren Bell
Mr. Melville P. Cummin

Sustaining Members

Mrs. Evelyn W. Adams
Messrs. James H. McGraw, George F. Singer.

Annual Members

Mesdames George A. Beardsley, Ethel Clyde, J. Clarence Davies, Clifton V. Edwards, Reginald E. Gillmor, R. M. Gunnison, Charles H. Hampton, Anna C. Jefferson, H. S. Manges, E. M. Murtaugh, Charles H. Talcott, E. C. Vogel, June E. Willis.

Misses Blanche Adler, Dorothy M. Blondel, Sybil M. Boland, Martha Carlson, Frances H. Dickerson, Christina M. Koehler, Ruth Lees, Christine M. Nilsson, Dorothy S. Nye, Beryl Parker, Phyllis Stanley, Ethel G. Stringfellow, Gertrude R. Wilson.

Doctors Martin Biederman, J. de Raismes Combes, Joseph Hajek, Robert M. Stecher, D. E. W. Wenstrand, Paul M. Wood.

Professor George G. Scott

Messrs. K. C. Atwood, Jr., William Felton Barrett, Aaron W. Berg, Robert O. Blair, Clayton P. Chamberlin, Alfred W. Church, Bernard Easterson, Ernest A. Edwards, Lanius D. Evans, Thomas B. Frank, Frank J. Fuhrmann, Howard S. Gans, G. Jarvis Geer, Francis Greer Goodman, John Henry Hammond, Joseph B. Hare, Chas. J. Hendrickson, William H. Hosford, Henry N. Jasper, Jonathan T. Lanman, Paul A. Lynch, Rowland R. McElvare, Francis W. Powers, Wm. A. Prendergast, John K. Prentice, Edwin H. Ranges, H. H. Roth, Frank L. Skeldon, Melvin Spencer, Charles N. Teetor, Lewis J. Trounstone, Herbert Waller, Arthur K. Woodman.

Associate Members

Mesdames Joseph J. Benjamin, B. R. Billings, Frances B. Bostwick, G. C. Bourne, Caroline M. Brown, William H. Bryan, Anne Cornell, Alan C. Doig, Peter Dolese, Helen W. Fields, D. D. Fischer, A. D. Foster, W. M. Garton, W. J. Gluckert, Henry T. Hall, Marjorie Hart, Robert Parsons Howell, Marion S. Jones, Frieda Keferstein, Leona M. Lee, Wilfred L. Letendre, J. Wallace McKenzie, Geo. W. Murray, A. E. Otto, L. C. Pardee, Edith Parish, Charlotte B. Perry, Anna Fairfield Pevoto, George J. Puckhafer, J. L. P. Robinson, W. A. Savage, Barbara M. Scholding, H. M. Spandau, Robert H. W. Strang, B. M. Walpole, C. W. Williams, John D. Williamson, Ira M. Young.

Mother Teresa

Sister Margaret

Misses Constance Avery Atwater, Mary Compton Aymar, Cora A. Beard, Marie Brahdry, Mae Carden, Kathryn E. Cooksey, Maybell Criner, Anna M. Cronin, Ethelwyn Doolittle, Helen B. Dorseheimer, Grace Eldridge, Frances R. Ferris, Elizabeth W. Fisher, Nellie D. Fisher, H. Forbes, Edith E. Giles, Dulcie E. Greenwood, Harriett L. Hamilton, Josephine S. Hannaford, Blanche B. Hanson, Edith Guild Henderson, Zada E. Herrick, Virginia L. Houghton, Ruby M. Jolliffe, Eleanor M. Kelly, Emma S. Kumfert, Stella Lefever, Nancy Lloyd, Nancy Norman, Nellie R. Nye, Marion T. Pleasants, Blume Regenbogen, Edna B. Richter, Alice T. Rowe, Vera M. Sakemiller, Charlotte Schuchardt, Ann Carter See, Ruth K. Shaw, Catherine Smith, Viola M. Sohn, Effie M. Sutch, Charlotte L.

Timmerman, Marion B. Warren, Lena R. Wellington, Jane A. Wilson, E. Frances Woodward.

Reverends Francis S. Majewski, Thornton B. Penfield, Otto Wendell.

Doctors Fred J. Badger, P. F. Brabec, Harry D. Brice, James B. Conant, H. F. Dailey, Michael Epstein, George Garthwaite Fisher, Lloyd W. Fisher, Harry W. Gauchat, Charles W. McClure, L. G. Morah, Wm. H. Park, Olin Sewall Pettingill, Jr., Myron A. Roberts.

Professor Carroll L. Courtney

Captain David D. Graves

Messrs. Richard N. Adams, R. J. Anderson, Stanley Arnold, Edwin Montgomery Bailey, Sr., Robert H. Baker, John E. Ball, Wm. Wallace Bancroft, Edward J. Banker, E. J. Bartlett, Ernest A. Batkins, Wm. S. Behrens, Fred Blumenthal, W. Chester Bottome, F. M. Boyce, Harry B. Braun, R. C. Casselberry, Eustace M. Chamberlain, C. A. Clapp, John Dodge Clark, Robert D. Coghill, Paul Connor, Harward W. Cram, Perry Davis, Joseph Dellapent, John A. Denison, Robert D. Denton, Nicholas Dietz, Amos F. Dixon, Ransom W. Edwards, Humphrey N. Ervin, James McNelledge Fadeley, Richard A. Fayram, Ruurd G. Fennema, Wayne H. Fisher, Jr., Robert G. Foster, L. Woodward Franzheim, Robert W. Fuller, Frank J. Garrett, Peter Dunne Garvan, F. A. Gaylord, H. M. Giffin, G. M. Goodman, Albert P. Gresser, Wm. H. Hampton, Wm. Albert Harbison, Russia Harris, William F. X. Harrison, Einar Hille, Samuel F. Holmes, Jonah H. Honig, Charles J. Hudson, Forrest R. Hughes, Ralph B. Hurlburt, Chester D. Jones, H. Thorn King, Jr., Samuel Knox, Charles F. Koughan, Frank H. Lamb, Louis Laroche, John E. Layton, Harold Levy, Arta Lewis, David C. Liebler, Arthur Long, Clarence Lyon, Frank S. Magee, Benjamin W. Morris, Jay Robert Morton, Ernest Mutschler, George Hewitt Myers, Charles E. Neil, Leslie F. Nims, Bobbie Novotny, John J. O'Connor, Edward O'Neil, Austin H. Parker, James Parker, Jr., Edgar H. Parkman, Y. C. Paschall, Harold C. Paull, Van Kirk B. Perkins, Rutherford C. Plaut, Allan K. Poole, Jr., Dewey M. Price, A. D. Purdy, J. A. Putnam, K. I. Rainesalo, William D. Reichmann, H. E. Riddleberger, John O. Roach, Lucien F. Rose, Lowell W. Saunders, Harrison M. Sayre, Emil Maro Schleicher, Oswald Schlockow, Julian E. Schonnengel, Max Schwabacher, R. Seibel, Henry B. Sell, Eugene Sheldon Shreve, Edwin G. Shuttleworth, W. H. Singer, Jr., Philip Holmes Smith, Merrill Snyder, Wm. H. Spahn, Joseph C. Spang, Clarence J. Stay, Theron D. Stay, Harry Stevens, William H. Stoffel, Harvey L. Sweetman, John A. Sweetser, Jr., R. P. Tappenden, Max Theiler, Glenn S. Thompson, Charles H. Topping, Charles T. Trace, Alfred W. Tyrol, Jr., R. S. Underhill, Norman J. Vile, John P. Wadham, Bradford H. Walker, Joseph A. Weber, John Hallock Welsh, G. W. Wharton, Jr., Wynant Wilday, Earl B. Wilkins, James Willits, Seth Wilson, Clement B. Wood, E. G. Woodbridge, Alex. Wooden, John G. Woodruff, Harry A. Wright, Daniel D. F. Yellott, Jr., Charles H. R. Young.

Reviews of New Books

Exploration, The Animal Kingdom, The Sea, Photography, Primitive Peoples

EXPLORING TO-DAY. By Lincoln Ellsworth. Dodd, Mead & Company, N. Y., 1935, Octavo, 194 pp. Illustrated.

SHORTLY before starting on his present hazardous Antarctic Expedition, Lincoln Ellsworth finished the writing of a book, *Exploring Today*, which should be in the hands of every youth and would-be explorer. In the course of the sixteen chapters, Ellsworth relates the trials and tribulations that he had to overcome before he became an explorer. He reveals that exploring expeditions today have definite objectives and that the personnel is, for the most part, highly specialized. Furthermore, he tells in detail just what an explorer's job consists of, how to prepare for it, and how to carry on. He dwells also upon the value of exploration to mankind. His advice to those who want to become explorers is to study the subjects in which they are particularly interested, and supplement this with such field work as can be arranged at or near home. The most interesting part of the book is the experiences of a selected group of explorers as told by the explorers themselves. The book is well printed, well illustrated, and timely.—CHESTER A. REEDS

OVER AFRICAN JUNGLES. By Martin Johnson. Harcourt, Brace & Co., New York. 1935, 263 pp., 100 photographs, \$3.75.

THIS latest account of the doings of Osa and Martin Johnson lives up to the expectations aroused by the earlier books and pictures of this much-traveled pair. In an excellent specimen of the book-maker's art, profusely illustrated by splendid photographs, and written in an entertaining manner, the Johnsons "go places and do things."

Over African Jungles is the story of the last expedition to Africa from which Martin Johnson brought back the film which later appeared under the title of "Baboona." The Johnsons have had a long experience in Africa and have known all of

the methods of transportation. They have progressed by stages from travel afoot to the comparative luxury of motor transport, but in this last undertaking they achieved the ultimate in travel by utilizing the airplane—two of them. The author brings out in a graphic account the great advantage to be derived from the use of the airplane. A journey which demanded 160 days from Stanley, at the cost of great discomfort and even the lives of many of his retinue, can be traversed in comfort, if not actual luxury, in a mere matter of hours.

The Johnsons lead an exciting existence and they do so many interesting things that it is difficult to select specific episodes for comment. Each day in the field has its program of activities which may vary from the physical transport of the party over vast stretches of wild country—an event of itself to thrill most people—to plans for an intimate association with wild life incident which may lead to all sorts of fast-moving and even dangerous developments. Threatened charges by lions and rhinoceroses seem to be a commonplace, and every now and then the charge becomes more than a threat, as might be expected when individuals insist on prying as deeply into the intimacies of African wild life as do the Johnsons.

The travel by airplane involved in *Over African Jungles* comprises 60,000 miles and the itinerary was sufficiently varied to present a cross section of animal life, including the native peoples, from the dry, desert lowlands to the high peaks. Certain features were planned for this expedition, among which might be mentioned the return visit to the pygmies of the Ituri Forest where the Johnsons had made friends on an earlier expedition, rambles among the lions on the Serengetti Plains, flights about the snowclad peaks such as Mt. Kilimanjaro, and the filming of a baboon colony later to be staged in "Baboona."

The text is written in an easy, narrative style, but it seems to this reviewer, at least, that the presentation might have been a little better

planned; and if the chapters had been given definite headings, it would have been easier to keep track of the chronological sequence of the expedition. However, this is, perhaps, of no great moment to the average reader who will be carried along by the story without any disturbing reflections upon sequence in time or place; it is only a reviewer who is forced by the nature of his assignment to card index and find a reason for everything. Suffice it to say that the reader will find *Over African Jungles* a book not only interesting to read but one in which he can feel a pride of permanent possession.

—H. E. ANTHONY

THE MAMMALS OF CONNECTICUT. By George G. Goodwin. *State Geological & Natural History Survey Bulletin No. 53, State of Connecticut. 1935, 221 pp, 33 plates, 19 fig.*

THE mammals of the Atlantic Seaboard have scarcely received their due share of attention in the recent writings of naturalists. Perhaps this is due to the fact that it is taken for granted that the mammals of the most thickly settled section of the United States are so well known and so much has already been said that it would not be worth the effort to carry out an intensive study of them at this late date. It is a common failing of human nature to be so interested in the far horizon that the things of value in one's own dooryard are completely overlooked. It is a fact that we still have much to learn about our eastern mammals, and the field is far from exhausted. For this reason it is particularly gratifying to note the appearance of Mr. Goodwin's comprehensive report on the mammals of Connecticut.

This volume is by all odds the most complete and the most satisfactory work on the mammals of any of our northeastern States. The basis for this report is data secured by several seasons of field collecting and by a careful search of literature and all available records. Because Connecticut has lost some of its original fauna such as the wolf and the panther, the old records are of particular significance today. However, these records are by no means as complete as one could wish, and mammals such as the moose and the wapiti which should, by every dictum of logic, have occurred in Connecticut, are nowhere reported to have done so. Students of our vanishing eastern wild life will find Mr. Goodwin's historical treatment of particular interest.

In discussing the present-day fauna, the author has followed a workmanlike presentation of data. He gives common and scientific names, a general description, and comments upon color and size, general geographical distribution, with a paragraph on the special distribution within Connecticut. This data is followed by an account of the life his-

tory of the species in question. Mr. Goodwin has drawn freely upon the life-history data recorded by other authors, but in the case of many species has added interesting comments based upon his own field observations.

The report is illustrated by sketches drawn by Francis B. Shields who has been quite successful in catching characteristic poses of his subjects.

It may be predicted for this report upon the mammals of Connecticut that it will prove to be not only interesting reading for the nature lover and a useful reference book for the student of the mammal fauna of Connecticut, but also a valuable contribution to the natural history survey of the State.—H. E. ANTHONY

A CHILD'S STORY OF THE ANIMAL WORLD. By Edward G. Huey. *Reynal and Hitchcock, New York. 335 pages. \$3.50. (indexed).*

THIS is a fine book for children between the ages of eight and twelve. It should also be considered as compulsory reading for natural science instructors in grade schools, and for natural history museum workers who wish to discover new methods of approach to teaching problems wherein children are concerned. Mr. Huey, of the Calvert School of Baltimore, knows his subject not less but his audience more. To run through the systematic gamut of animal life from amoeba to gorilla in a single volume is certainly an ambitious project in itself. To present this same material for the enjoyment and enlightenment of children becomes a task that few have accomplished successfully. The author has succeeded so well that his handsome, large book at once becomes the answer to a long felt need.

The volume is in twelve carefully planned parts. The first, "tells what animals are made of, who belongs to the Animal Kingdom, and many surprising facts about some animals that look like plants." Part two relates entertainingly "about the animals with jointed legs, that zoölogists call Arthropods: also how to tell a spider from an insect and why the lobster is cousin to both."

The chapters go on to tell of the sequence from "oysters to octopus," "the age of reptiles," and all the way to part seven "which will make you sit up and take notice, with its stories of the queerest mammals—those that lay eggs and those that have pockets." The final part "discloses the mystery behind the facts (in this book) and tells why zoölogy opens the door to all kinds of fascinating things in the world about you." The chapter on evolution "How and Why" offers the best introduction to this subject for children that we have ever read.

An eleven-year-old boy visited our Bear Mountain Trailside Museum office a short time ago. He was to enter a hospital on the following day for an operation that would ultimately place his leg in a

plaster cast for two months. Mr. Huey's work lay on my table, together with a number of other books. While the boy's mother talked with me, he at once began turning the pages of the *Animal World*. As he looked at the pictures and read here and there for a space of twenty minutes, his mother explained that she had brought the boy to our out-of-door museum to "keep his mind off himself" until the morrow, and also to secure advice as to how he might be diverted during the long weeks of pain and inaction that lay ahead.

"Could you suggest any books for him," she asked.

Without awaiting our answer, the boy, with eyes bright, asked "Couldn't I have this one, mother?"

In the last analysis the child himself will be the critic of books intended for his use. We could think of no better recommendation than a recital of the above incident. Perhaps if Mr. Huey reads this review, he will wish to send a copy of his book to the boy who liked it!

The greater number of the splendid illustrations are from both the American Museum of Natural History and the New York Zoological Society. This might indicate that the book has somewhat of a "museum plan" and so it has, justly and unavoidably. A book of this character must, of necessity, be planned as a zoological outline—a black and white representation of systematic natural history museum displays, if you will. This is decidedly in its favor.

William H. Hudson, who objected so strenuously to "stuffed specimens" admitted in *Birds and Man* that museum exhibits "might be made useful to young students of zoölogy." Mr. Hudson might have altered his expressed opinion that mounted animals are a "falsification and degradation of nature," if he could have seen a modern museum of today. The truth is that books of this sort and museum displays, too, are essential to any broad zoölogical study on the part of children. It would, of course, be an impossibility for a child to observe all of the creatures mentioned, in the field. The book thus serves the purpose of acquainting its youthful readers with all types of creatures to the end that he may become better equipped to appreciate the familiar wild life about his home and in his summer camp. The museum illustrations, especially of the lower animals, are indispensable. The numerous line drawings by H. R. Daugherty and Olive Earle are of distinct worth, too.

Simplicity of expression, clarity of ideas, and soundness of fact, combined with a straightforward, sane, man to man discussion, without a hint of "talking down," are all essentials that must be incorporated in any popular science reader that a child will take to his heart. This book fulfills all of the above qualifications and, in addition, has a personality of its own.—W. H. CARR

PARADE OF THE ANIMAL KINGDOM. By Robert Hegner. The Macmillan Company, New York. 675 pages, 743 illustrations. \$5.00, (indexed).

THIS large volume (it weighs five pounds), might well be a companion to *A Child's Story of the Animal World*, reviewed above. It is distinctly intended as a book for adults, yet the superb series of pictures would delight any child. Doctor Hegner's parade would require many hours to pass a given point and the entire procession would hold the onlooker's interest and close attention to the end.

The book is a revelation in concise, popular-scientific writing. Doctor Hegner, who is professor of protozoölogy in Johns Hopkins University, marshals his forces in orthodox fashion from protozoa to mammals. The chapter on the "First Animals" treats a subject, difficult to popularize adequately, with a keen appreciation of the general reader's viewpoint and with the highest regard for accuracy.

Life history studies are given for each type of animal. A careful explanation in each instance tells of habitat, enemies, food, locomotion, methods of self preservation and of reproduction. The subject balance is excellent. There is no trace of over-emphasis upon any one group of creatures.

Doctor Hegner writes with wit and charm. In describing a living place of the hedgehog hydroid, he remarks that "Only an overworked imagination could conceive of such a bizarre place to live as the top of a snail shell inhabited by a hermit crab." The description of the animal itself and the treatment accorded the coelentrates as a whole ranks high in the entire book.

In introducing this group, the author asks, "How would you like to be nothing but an animated stomach with perhaps a load of superfluous jelly to make you look stout and prosperous? If you think this would please you, we suggest that you study the group of animals we call Coelentrates, a word that means 'hollow intestine.'"

Did we say that this was a book for adults only? Change three words in the above paragraph and what child would not understand?

The chapter dealing with Amphibia begins in this way: "In many respects the Amphibia, such as Frogs and Salamanders, lead an enviable and carefree existence. The Greeks gave them the name Amphibia which means 'double life,' but this double life has nothing to condemn it, since it simply refers to the habit of spending part of the time on land and the rest of the time in the water. In fact, a sort of summer vacation on a river or lake or at the sea shore, delightfully extended throughout the year, with a swim whenever desired and sun baths galore."

Slight excursions into the realms of generalization and anthropomorphism should by no means

discourage readers of encyclopædic books. Nevertheless, if a salamander in our northern country "desired" to swim and enjoy a sun bath in mid January, we fear it would be frequently disappointed! Forgive me, Doctor Hegner, but there it is!

This book should prove of the very first value in school, museum, and public libraries, as a ready reference for inquiring students of general zoölogy. Its scope is so all-embracing that it is impossible to convey any idea of its worth by merely quoting several paragraphs as above. Any naturalist or nature student would be glad to own this volume. We would also like to recommend this book to nature teachers and to nature trail builders.—W. H. CARR

THE SEA FOR SAM. By W. Maxwell Reed and Wilfrid S. Bronson. Harcourt, Brace and Company, Inc., New York, 1935.

THIS is the story of the seas from the days when the world was new. W. Maxwell Reed, writing with young readers in mind, describes first the formation of the earth, then the earth's capture of its satellite, the moon, so important a factor in the movement of the seas. The story of how the continents apparently float about over a fluid mass beneath the earth's shell and of how the continents are continually being raised and lowered, often a rather involved concept, is presented in a very clear and lucid manner not only for the young person to whom it is addressed but also for the more mature reader. The history of the seas, as told here, appears to favor the Wegener theory of the separation of the continents. That is to say, one great continent, Pangea, was present in the early days of the world and for hundreds of millions of years remained the sole land mass. Then during the Cretaceous it began to split up. The Western Hemisphere broke loose and the rift between Pangea and this new world became the Atlantic Ocean.

The discovery and exploration of the seas from the times of the Greeks to the circumnavigation of the globe by Magellan is discussed in an all too brief chapter. The theme returns to the more physical aspects of the sea with a description of the ocean bottom could we walk through its canyons, climb its mountains, and traverse its plains. Several extremely interesting chapters on the waves and tides follow.

At this point the story is taken up by Wilfrid S. Bronson, who has written and illustrated the portion of the book dealing with life in the seas. He writes of almost all of the main groups of invertebrated animals from the simple protozoa through the fishes to the sea-living mammals. Mr. Bronson has done an excellent job, for he not only describes the animals themselves with a rare freshness, but

manages to impart something of the unsuspected turmoil of life beneath the waves.

Mr. Reed then tells of the Gulf Stream, other ocean currents, and the formation of icebergs, their size and their eventual breaking up. An interesting chapter, contributed by F. C. Brown, describes how, by means of tides, winds, ocean currents, evaporation and rain, the sea mixes the many organic and inorganic elements entering it.

The last portion of the book gives the reader a glimpse of how theories are made, disproven, and sometimes forgotten. An account of Charles B. Lipman's amazing discovery of living "germs" imbedded in coal fifty million years old and in specimens of rock meteors is accompanied by the admonition that acceptance of this as a definite fact must rely upon a preponderance of evidence in its favor and also upon a critical examination of the conditions surrounding its discovery. Could not these "germs" have entered the coal at a later time? By questions such as this Mr. Reed introduces the young reader to the scientific, objective frame of mind.

The collaborators have successfully tackled the staggering task of portraying the sea's physical aspects and its teeming life with no sacrifice of fact for fancy. The book is exceptionally well illustrated with photographs, Mr. Bronson's drawings of undersea life, which are especially effective, and diagrams borrowed from the literature of geology. A unique feature of the presentation, the constant challenge to the young reader to weigh statement and conjecture, to demand sufficient evidence before acceptance, and to consider hypothetical working bases as such and as no more, is a philosophy of which many adults are incapable much less a child of twelve.

It is unfortunate that the publishers have determined on the age-limits of twelve years and up. The story flows along very smoothly, but because of some of the ideas involved, must needs draw upon a vocabulary certainly several years above that of the twelve-year-old. For a sophomore or junior in high school, or in fact for any interested adult it is a fine book.—G. MILES CONRAD

THE ALLIGATOR'S LIFE HISTORY. By E. A. Mcllhenny. 117 pp. 18 figs. Christopher Publishing House, Boston.

THE alligator, the largest American reptile, has been extensively studied by embryologists and anatomists; but its life history, its daily habits and contacts have remained largely conjectural. Strange though it may seem, much more was known of the social life of a Madagascar crocodile than of our own familiar 'gator. But now thanks to the careful studies of a naturalist born and raised in the heart of the Louisiana alligator country, this much

needed information has been worked out and published in book form. Mr. E. A. McIlhenny has seen fit to present his studies in popular style. Probably few of his readers will realize how many original and important contributions to animal behavior are compressed within these few pages.

McIlhenny's book definitely establishes the fact that the mother alligator defends her nest, and takes care of her brood over one winter. There is some evidence that she even feeds them. Males have definite dens to which they return, often from great distances, year after year. The bellow of the male alligator, like the call of many male birds, is an advertisement that a particular territory is occupied. Females are not able to bellow, but they can give a guttural snarl—in reply to the male. The musk glands which have always been considered alluring devices are often emptied of their pungent odors during fights between males. Hence they may aid in defense as well as in attraction of the opposite sex.

Some of the most interesting sections of the book give a first-hand account of nest building, den digging, and methods of feeding. "Alligators seem to know the difference between poisonous snakes and non-poisonous snakes. When an alligator catches a cotton-mouth moccasin, which is a poisonous snake, as soon as the snake is grasped in its mouth it is shaken vigorously until quite dead. When a non-poisonous snake is caught, it is not shaken, but killed by being crushed between the jaws." It further seems that alligators must rise to the surface if they are to chew their food. Objects that can be swallowed whole are disposed of while submerged.

The alligator has the richest mental life by far of any American reptile. The rapid disappearance of this magnificent species from many parts of the South is greatly to be regretted. McIlhenny records an eighteen-foot specimen shot in 1879, and describes his difficulties in obtaining large specimens in recent times. He has shown how alligators rapidly increase when protected. It is to be hoped that the splendid little book McIlhenny has published will arouse a greater interest in the personal every-day life of America's largest saurian. It is only by such interest that one can hope to secure adequate protection.—G. K. N.

HANDBOOK OF THE HEAVENS. Edited by Hubert J. Bernhard, Dorothy A. Bennett, and Hugh S. Rice. Whittlesey House, McGraw-Hill Book Co., New York. \$1.00.

PERHAPS the most difficult task for one who wishes to acquire a general knowledge of astronomy is the "breaking in." Text books seem rather pedantic and too full of information, and if the novice associates with those interested in the sciences, their superior acquaintance rather awes him. It is to initiate such novices that the *Hand-*

book of the Heavens has been prepared. While written under the auspices of the Junior Astronomy Club, it is not childish in form. Its general arrangement is that by which man originally learned the sciences. The first quarter of the book deals with the constellations, with charts for the seasons and detail maps for the different sections of the sky. Sufficient text accompanies these maps to describe the ancient groups and make them live for the observer.

The next quarter of the book treats of the Solar System, and discusses the earth's companions, the planets, and the moon. Then meteors and comets are given brief mention but sufficient to encourage one to hunt farther for more information. It is in this section the telescope appears. Man's knowledge of the Solar System grew by leaps and bounds after Galileo applied his glass to the sky. And that same vista opens here for the student. If he has a small instrument available he is encouraged to use it, but if not, the pictures in the book must satisfy him.

The latter half of the book deals with more telescopic objects, double and variable stars, nebulae and clusters. Eclipses and asteroids are given a place. The chapters on the use of the telescope and photography will interest many.

In so short a book no subject can be adequately treated. It is not the intention to do so and the editors and authors would have misplaced their energy had they tried. So many books divulge the special interest of the writer by an over-emphasis on that subject at the cost of adequate space for something else. By collaboration this was avoided in the *Handbook of the Heavens*.

A glossary closes the book and for the benefit of the veriest beginner it might be enlarged to include many words innocently used in the body of the book but not sufficiently defined there. A valuable addition would be a recommended list of books for further reading, perhaps one good book on each of the subjects mentioned.

—WM. H. BARTON, JR.

THE CHINESE. THEIR HISTORY AND CULTURE. By Kenneth Scott Latourette. 2nd ed. combining Vols. I and II in one book. The Macmillan Company, New York. \$6.00.

TO this reviewer, who lays no claims to a very profound knowledge of Chinese history and culture, this massive book by Professor Latourette is a welcome and handy guide into a field ordinarily omitted in the education of westerners. The plan and the content of the book is as simple as it is logical. After a brief geographical description of the area which was to be the scene of the Chinese drama, we are led into a discussion of the interrelationship of environment with the political and cultural characteristics of various sections of China. Then follows a section on the origin of Chinese civilization both from archaeological and

traditional evidence. With the preliminary spade work accomplished, the historical China emerges. Its successive dynasties and its political vicissitudes are examined succinctly and clearly. The second volume is confined to the treatment of the principal aspects of Chinese life under such heads as government, economic life and organization, religion, social life and organization, art, language, literature, and education.

The detail in Chinese history is so vast and the ramifications of its culture so complex that more than two volumes would be necessary to satisfy a specialist. Therefore, it is hardly just to quarrel with Professor Latourette for his omissions. But it seems to this reviewer that the sections on the various expressions of art and literature are rather perfunctory. The connections with the esthetic development of the west are largely neglected and the discussions of some of the art forms are too thin to be more than superficial. One has a feeling that they are mentioned for the sake of completeness and not for the light they shed on Chinese character and Chinese civilization.

The reader, however, cannot but be impressed by the vast range of Professor Latourette's scholarship, by the catholicity of his selection of authority, and by his pleasant style. It is a vivid picture that he limns of the most ancient civilization in the world with a continuously vital civilization. For the busy adult who is eager to acquire a familiarity with the gargantuan outlines of a fascinating country, this book is to be recommended.—H. L. S.

THE COLLARED LIZARD: A LABORATORY GUIDE. By D. Dwight Davis. New York, The Macmillan Company. 1934.

THIS is a short concise guide to the dissection of the collared lizard. It is sufficiently detailed, however, to give the student a comprehensive view of reptilian anatomy. Too often in an undergraduate course of comparative vertebrate anatomy the reptiles are dismissed with one or two classroom lectures or at best a laboratory study of an atypical form such as the turtle. Thus it would seem that Mr. Davis's choice of the lizard is fortunate, for this form is one of the least specialized of the existing members of the class and it is also readily available.—G. MILES CONRAD

WELLCOME PHOTOGRAPHIC EXPOSURE CALCULATOR HANDBOOK AND DIARY 1936. Issued by Burroughs Wellcome & Co., \$0.75.

AS in former years this little volume contains much condensed information concerning photography. Naturally the use of the products made by the company that issues the book is stressed, but this does not detract from the useful-

ness of the general statements. The blank pages for recording the conditions under which pictures are made should remind amateurs not to neglect this important step in developing their skill. The exposure calculator is about as perfect as one that does not actually measure the light can be made.

—F. E. LUTZ

PRIMITIVES AND THE SUPERNATURAL. By Levy-Bruhl, Lucien. E. P. Dutton and Co., New York, 1935. \$5.00.

FOR many years now, Professor Levy-Bruhl has devoted his amazing resourcefulness and energy to tracking down, in likely and unlikely places, in the accounts of missionaries, travelers, and ethnographers, odd and bizarre facts about the way in which the mind of primitive man works. This book is less oriented to one basic idea than have been his others; it is more a collection of odds and ends of strange ideas and practices, about which Professor Levy-Bruhl can express—as he has so often expressed before—his unfailing amazement that primitive man is not as logical as he thinks modern man is, or should be. The book should interest especially two types of readers, those who are wont to report, carelessly and gaily upon the customs of the natives whom they may chance to encounter in their wanderings, and those who like to meditate upon how logical we ourselves have become. The first class of reader, the explorer, the naturalist, the interested and note-taking traveler, will have an opportunity to see how strange an assortment can be made up out of chance observations such as he brings back to civilization. The second reader, he who thinks we are logical and scientific, has only to cudgel his brains a very little to find examples of equally pre-logical thinking among ourselves.

While the pages are filled with the vivid, bizarre, and arresting, they nevertheless are organized to no point which is new or revealing. Modern ethnological research deals not with Primitives or with "the Primitive," but with many and diverse primitive peoples, each with a view of life which contains its authenticities and its amazing contradictions—when seen from the outside. Professor Levy-Bruhl in his comments is essentially the cultivated Frenchman who believes that the substitution of the metric system for systems with an older history and more internal contradictions, means a genuine revolution in the way in which people think. He is content to wonder and to comment on the ways of those who know not the metric system and its analogues, and in so doing he fails to explore the rich and diverse possibilities for understanding, not the "primitive mind" but the human mind, which material on primitive peoples offers us.—MARGARET MEAD

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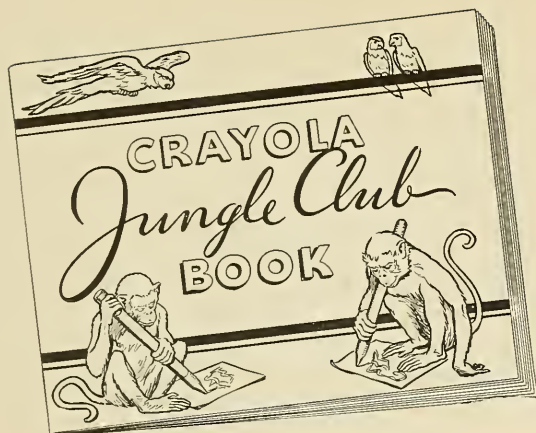


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NATURAL HISTORY

The Journal of the American Museum of Natural History

VOLUME XXXVII



FEBRUARY 1936

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THE LARGEST SHRINE IN TIBET

Embellished with gold leaf, the roof of this striking structure gleams brightly in the rarefied air of over 13,000 feet. Gyantse, where it is located, is the third largest city in Tibet

and was an early halting place on the journey which took Suydam Cutting and Arthur Ver-nay to the mysterious city of Lhasa, the abode of the supreme ruler of Tibet

Mr. Cutting tells here the story of his unique negotiations with the Dalai Lama, incarnation of Buddha, master of the Potala palace-monastery and supreme ruler of Tibet; and of his subsequent visit to the forbidden city. He took the first motion pictures of Lhasa; and the photographs reproduced here from his extensive collection, are the most extraordinary ever shown of this mysterious city.

In Lhasa — The Forbidden

An extraordinary trip to a city which few explorers have reached, where the palace-monastery of the Dalai Lama stands supreme

By C. SUYDAM CUTTING

Trustee, American Museum of Natural History

THE explorer who tries to visit Lhasa is confronted by a political and religious bulwark that is well-nigh impossible to penetrate. Tibet is a closed country to all foreigners, and Lhasa, the abode of the Dalai Lama, is guarded probably more closely than any other city in the world.

The first definite progress that the writer made toward gaining entrance to Lhasa was in 1928. In that year application was made by the Roosevelts through the Government of India for a permit to cross the southeastern corner of Tibet en route to the Chinese province of west Szechwan.

His Highness the Dalai Lama

The proposed expedition, in company with Theodore and Kermit Roosevelt, had no immediate bearing on Lhasa, but it was the beginning of negotiations with the Dalai Lama. One must begin there in a small way. Lieut. Col. F. M. Bailey, the political officer at the frontier who handled the request, thought there was no chance of gaining entrance even to this corner of Tibet, but some months after the original communication had gone up to Lhasa, an affirmative answer was received.

The ensuing expedition never actually

utilized the permit, for an alternative route to the destination was followed. But the significance of this contact in view of subsequent events, was enormous. It was the opening wedge.

Strengthening relations

That winter we journeyed in high country along the Tibetan border of China, a region inhabited by the Tibetans, Lolo, and Nashi. Then in 1930 followed a trip to Gyantse. Foreigners are permitted by treaty in limited numbers to visit this city, about a hundred miles beyond the Tibetan border. But a solemn promise over one's signature states that one will not travel beyond the immediate vicinity of the city. Here was another opportunity to press negotiations, and it was not lost. A letter in Tibetan requesting permission for further travel was dispatched accompanied by the conventional scarf to the Dalai Lama. Also many presents were distributed.

The two head men at Phari at the border were given decorative Hammacher Schlemmer aluminum ware, and the Governor at Gyantse received a cuckoo clock. Each of the five members of the Kashag, or High Council at Lhasa, was sent a self-winding wrist watch. The Dalai Lama's presents naturally had to be chosen with especial care. A gold self-wind-

ing wrist watch was only the beginning of his gifts.

He was a man of fifty-seven, shrewd in the ways of statecraft. But on the gentler side, it was known that he loved animals enormously. He had always wanted Lieut. Col. Bailey, the frontier officer, to send him, of all things, an ostrich. He must have seen a picture of one. But as Lieut. Col. Bailey tried to explain to him, it would have been impossible for an ostrich to survive the rigors of travel to the Tibetan plateau. Hoping to provide something equally amusing, I sent the Dalai Lama a pair of dachshunds. A week went by and then a telegram came from him which showed that some interest was being taken in the animals. He asked what their names were.

A week later, however, came his answer to our petition. Permission to visit Lhasa was denied; but, great luck, the caravan could cross the nomad country on its way back and visit the city of Khampa Dzong. The letter stated that there was general disapproval of strangers traveling into the interior of Tibet; but he and the Kashag gave permission and hoped I would have a pleasant journey.

The British had shown great consideration by allowing me, with the local Tibetan Governor's permission, to wander anywhere I wished in the great Gyantse Valley, which was ordinarily forbidden country. The proper Tibetan permits were made out, and every Tibetan was kindness itself, including the Governor of Khampa Dzong, who invited me to stay at his house and was the deserving recipient of my last remaining cuckoo clock.

I was closer to Lhasa than ever before. Friendly relations had definitely been started.

Letters from the Dalai Lama

In the following years a number of letters came from the Dalai Lama. The Tibetan script, on native paper, was always accompanied by a typewritten translation, done by the Dalai Lama's secretary. Both are contained in an intricate envelope addressed in both Tibetan and English, and sealed with the official seal. Our correspondence had much to do with the affairs of Tibet. I was asked to see if wool merchants in the United States would buy Tibetan wool via Calcutta. In response to this, several merchants were induced to write to Pangda Tshang of Upper Bengal and Lhasa, who has the monopoly in this product,

which is used in the manufacture of carpets. These negotiations have not progressed as favorably as they might, however, and the matter is still one of my considerations.

An autographed portrait of Hoover

Letters were also entrusted to me to be delivered to the State Department of the United States. The Dalai Lama wished to establish good will, although for diplomatic reasons there could be no direct communications between the governments. The letters were duly answered and sent back by me with an autographed photograph of President Hoover. Finally I was even asked to induce the United States Congress to buy silver and send it to Tibet in bond. This was an attempt to avoid the India export tax, and was quite hopeless for several reasons, but it gave me an excellent chance to send a letter bearing the letterhead of Congress.

When negotiating with orientals, anything that enhances one's importance never fails to benefit one. For this reason I always made it a point to write to the Dalai Lama every time I could use imposing stationery. The Dalai Lama knew that the Viceroy of India strongly backed my purpose to visit Lhasa, but the mere fact of my knowing him counted, too. So I was careful to write to Lhasa on the household note paper of the Viceroy, also on that of the Commander-in-chief, whom fortunately I also knew—never on hotel paper.

All this time presents were going back and forth. I sent the Dalai Lama a long glass cocktail shaker which, though it would not serve him in the ordinary manner, would be useful in mixing his buttered tea; also illustrated books on American architecture, a chair with a folding canopy, silver plated polar bears on agate, an ornamental glass bowl, and some fine woolen blankets. The dachshunds, as well as a pair of Dalmatians which I sent later, are still alive, but they have never produced puppies.

The Dalai Lama sent me Tibetan *Apso* dogs in three lots, which unlike my gift, are breeding successfully.

The Dalai Lama continued to write regularly. Whenever I came to India I was to advise him of the fact, and so forth.

Then in December, 1933, he died. The cable from his personal assistant reached me on Christmas day, notifying me of the "tem-

porary passing away” of the incarnation of Buddha. (His successor must come from among the children born on the night he died and is selected by the priests by omens. But to date, his successor has not been discovered.)

“Knowing your constant correspondence with late Holiness,” the cable read, “hope to receive assurance of continuance of your friendship at this unfortunate conjuncture.”

So following the sad death of one who had become a real friend, correspondence continued with the Kashag, or High Council.

Later in 1934 with permission from Lhasa

there was a plan to go to Southeastern Tibet with the Roosevelts and to cross a big section of the plateau; and it was hoped that this might be the time for Lhasa. But because this expedition was to be chiefly for the purpose of collecting animals, and since shooting is counter to Buddhist law, we dropped the project.

Therefore, when Mr. Vernay and I planned the expedition described in this article, anthropological and botanical collections were the object of it, not hunting.

Negotiations this time went smoothly. My name was by now well known in high circles



ROUTE OF THE EXPEDITION TO LHASA

The dotted line indicates the route taken. Lofty passes separate Central Tibet, where Shigatse and Lhasa are located, from India. The Tibetan Plateau is intersected by moun-

tains and habitable valleys. Up to 14,000 feet agriculture produces peas, barley, and hay; above that to 16,000 feet nomads roam with their sheep, yaks, and goats

in Lhasa, I had always kept my promises with the government, and had endeavored to help the Dalai Lama in various ways. Permission to visit Shigatse only was granted, but we hoped that once we had reached this sacred city we might be allowed to proceed to Lhasa. And we started out from England early last July with great expectations.

Our first objective, Shigatse, is second only to Lhasa in size and political importance. It is the official residence of the Tashi Lama (Panchen Rimpochi) who is the spiritual head of the Buddhist world. Political reasons several years ago, during the life of the late Dalai Lama, caused the Tashi Lama to leave Tibet and take up his residence in China, where he still resides. At the present time there is a good deal of active talk as to his return to Shigatse in the summer of 1936, but the matter is shrouded in political intrigue which cannot now be discussed.

To reach Shigatse, which lies at an altitude of 12,800 feet, one follows either of two routes from India: one via Gyantse and the other via Khampa Dzong. The distance by the latter route is shorter, being 183 miles from northern Sikkim as against 236, but it is also by far the higher, crossing one pass that is over 17,000 feet. We chose the former route.

The passport which allows strangers to enter the interior of Tibet is a document written in Tibetan and bearing the Kashag's seal. Presentation of this document along the specified route of travel always brings immediate recognition. We actually carried two letters, however—one the regular passport, and the other in the form of a red pennant, which they call an "arrow letter." This letter proved of infinite convenience to us, and its use merits explanation.

A courier

When traveling in Tibet, it is the custom to change pack animals as often as required, and so to apportion this business amongst the various villages. Distances are consequently divided according to where the changes occur, and, since we nearly always made double marches, the routine was to change animals twice a day. Here is where the "arrow letter" became so valuable, for it traveled ahead of us by one or two days. Its presentation notified villagers and gave them ample time to collect their animals, which might be miles distant, tucked away in

some valley where there was good pasturage.

Anyone who travels in the interior of Tibet will invariably be struck sooner or later with the realization that the country has never changed. Countries sometimes are so backward that they appear still to be existing in the seventeenth century or thereabouts. But with Tibet, the period could easily be a thousand years or more ago, and for this situation there are definite reasons.

A closed country

Consider the term "Forbidden Land," which is so often applied to Tibet. Along its southern border lie Nepal, an independent Hindu kingdom of Mongolian stock, and two native states of India, Sikkim and Bhutan, both of Tibetan stock. Natives of these three are allowed into Tibet, and do some trading with the inhabitants; but Tibet's racial intercourse ends here. Indians from India and those other races who live along the far-flung frontiers of Tibet may not enter, nor are any permanent resident government representatives allowed. Prompted largely by religious motives, the nation, an ecclesiastical one much dominated by Buddhist priests, will not tolerate foreigners or foreign customs and products.

In view of this and of the fact that the country is practically self-supporting, with a plethora of everything needed in daily life, it is not hard to understand why Tibet has not changed and why no one in the country particularly wants it to.

The social order is a complete feudal system such as existed in Europe during the tenth century. How truly fascinating it is to travel there, to live in the houses of the natives, to rub shoulders with them, eat Tibetan food in company, and to know all the time that the culture and manners are a changeless relic of a forgotten era. Add to this that the people of all ranks are charming and virile, that they possess a fine sense of humor and are ultra polite, and that they live in strong, well-built houses amply comfortable, and you can understand that exploring in Tibet can be most interesting and delightful.

One is at first somewhat surprised at the peculiar salutation received everywhere from the common people. Any peasant upon approaching a foreigner or nobleman sticks out his tongue and holds it out for a second or two. This is the polite gesture of greeting.

The Tibetan plateau is a country of very different altitudes. Shigatse and Lhasa lie in Central Tibet, where although the land is not as high as in the regions to the north and south the altitude is nevertheless extreme. The plateau is intersected by hills and mountains, graced here and there with high snow-capped peaks. It is a land of habitable valleys that range from gorges to vast plains. The higher the altitude the less fertile the land and more rigorous the climate.

Agriculture, which produces largely peas, barley, and hay, becomes scanty at over 14,000 feet. Here crop raisers begin to merge with the nomads, who roam with their herds of sheep, yaks, and goats up to 16,000 feet.

Anywhere on the plateau the climate is naturally a cold one, and even if people from south of the Himalayas were permitted to settle in Tibet, the altitude and cold would make their environment absolutely unsuited to their welfare and health. The winters, except to those inured to them for generations, are unbearable. During this season the higher one goes the more one is subjected to icy southeast winds which, blowing a full gale during the daylight hours, raise fearsome clouds of dust often mixed with snow that go hurtling over the great grasslands.

Traveling conditions

Summer is the proper time to visit this country, but the summer is short. At 14,000 feet early July is still coldish with possible snow flurries, and August is the period of rain everywhere. Usually during this latter month the mornings are clear, but cloud banks from the western mountain tops soon cover the valleys and by one o'clock a sweeping cold rain has arrived, often accompanied by hail.

The Central area is part of the watershed of the mighty Tsang Po River (Brahmaputra). This river is fed by innumerable tributaries that rise from upland springs and snows. All during August the many rushing streams are muddy from the masses of silt the rain has washed down from the mountain-sides. From the middle of September on through October the weather at 12,000 feet is perfect with a brilliant warm sun all day every day, yet with frost at night. This is the fine weather period, yet by mid-October at 14,000 feet the autumn is well under way and the cold winds are in full sway.

From this it is easy to understand that Tibetans must be a hardy race, particularly as there is little fuel in this bare country.

A splendid reception

Shigatse is situated in a huge, lovely valley surrounded by mountains. Our approach, late one afternoon, followed the river Nyang Chu, which three miles north of the city debouches into the Tsang Po. The first landmark one sees, arriving from any direction, is the great lamasery of Tashi Lhunpo, situated near the base of a mountain slope about a mile from the city. Its many gilded temple roofs completely dominate the landscape. Thirty-five hundred lamas reside here.

Word of our arrival had been sent ahead, and a splendid reception had been prepared. Guides met us at the outskirts, and the crowds which milled about our caravan as we passed through the narrow streets of the poorer section made our progress seem like a triumphal entry. We passed on to what might be classed as the more well-to-do residential quarter, and stopped at a house which was lent to us by the nephew of the Tashi Lama. There a small reception group awaited us. Buttered tea, the staple of Tibet appeared, and we were introduced to two gentlemen who were to act as permanent ADC's during our sojourn.

One wing of the house, situated in a lovely park, had been made ready to receive us and was hung with draperies and banners; also there was additional space for servants and kitchen. While on trail and stopping at different native houses, our permits required us to pay for rent and all other accessories we might want, which the natives were required to supply us at current rates. Here in Shigatse, however, the house was a gift of the Government and everything was made as comfortable as possible in true Tibetan fashion.

Next morning, as definite etiquette required, we started to make our round of calls on the high officials. These comprised three: the Governor in Tashi Lhunpo (a very high Lama, indeed the ranking authority of the district), a second very high Lama, and lastly the Dzong Pen or Civil Governor, who lived in the Dzong or city fort.

The high lama's residence was at the top of a tall massive building, and was reached by climbing a series of great wooden ladders (stairs are practically unknown in Tibet). He

occupied two floors, which were divided into sitting rooms, verandas shaded by awnings, sleeping quarters, and a shrine corresponding to a private chapel.

We sat down to buttered tea and native sweetmeats, such as one would have at any social call in Tibet. The conversation, as always, was begun with platitudes and politeness—"Do you feel tired after your long journey? Were you treated well on the way? Is your house comfortable?" etc. etc. Conversation was much facilitated by a native woman of Shigatse who once had been an ayah in both Calcutta and Darjeeling and could do excellent English-Tibetan translation. She remained with us during the stay of ten days. The Governor promised for us a special review of 500 city troops of the regular army on the morrow; and with the usual polite salutations we took our leave and passed on to other calls.

First the Lama, then the Dzong Pen. These calls were similar and plenty of buttered tea was served at both. Living quarters of these officials, in sharp contrast to the massive grim exterior of the building they were in, were quite attractive. We had presents for each, which according to custom were presented to a servant on first entering and then no further attention whatsoever was paid to them. Tibetan scarfs had, of course, been properly exchanged.

Outdoor parties

Except, now, for the return calls, of which there were only two, for the High Lama pleaded his age as the excuse for not visiting us, the stricter formalities were over and we came to the lesser formalities such as lunch parties; these were truly delightful affairs. The weather, which had been very rainy, had just cleared up and the gentry of the city had decided, as is customary throughout Tibet during the fine weather, to hold such parties in the fine parks under their big summer tents. Three of these parties were held—one in the park of each of the Tashi Lama's summer palaces and one in our own park.

The tents are pitched in the shade of specially planted poplars (trees do not grow naturally as the plateau is above the tree-line); then from noon onward one or more days are spent there. A field kitchen is set up in a small adjoining tent where a mid-day meal is prepared. Recreation takes the form either of chatting or, what is very common, competition in archery, a sport

for which there is real enthusiasm. The arrow, a curious one with a blunt perforated head that causes it to whistle as it passes through the air, is shot at a target from a range of about fifty yards.

Soldiers and priests

Two interesting shows were put on. The first was the military parade in the city's parade ground. There is little point in discussing the details of this affair other than to say that the troops did not seem all to have been chosen from the better physical elements of the population. The band, it might be said, which with leopard skins was somewhat modeled after native British units, played far better than the marching of the men, in their ill-fitting uniforms, merited. The parade was followed by a buttered tea party at the Colonel's house.

The other show, which was of great interest indeed, was a concentration in full regalia, maroon cloaks and yellow hats, of all the 3500 Lamas of Tashi Lhunpo. They congregated *en masse* in a great court of the lamasery which was dominated on one end by a raised dais on which stood the now empty seat or throne of the absent Tashi Lama. They remained in this court half an hour milling around and chatting together, amused and unperturbed by the moving picture camera, for the use of which the Abbot had given his permission.

Our real objective here as elsewhere was the acquisition of a botanical and anthropological collection for the Kew Gardens of England and the American Museum of Natural History respectively. As soon as the populace learned of the latter interest, masses of people congregated outside our house with many articles of ethnological value to sell. All the things which the Tibetans use in their daily life and the objects used ceremonially in the temples were offered for sale. This was exactly what we wanted.

As for plants we had to go slightly farther afield, as the near surroundings of the city were intensely cultivated and the land immediately beyond was quite barren of any flora. A trip to the Tsang Po valley, however, was excitingly successful, and a few days collecting proved highly gratifying.

A last word for Shigatse. Most of the streets are broad and clean and there is no congestion of population. It is true that it teems with beggars, most of whom are blind, yet what Tibetan

city does not? It is as hospitable a city as one could wish for.

It is the custom of the Tibetans to return presents, and this is what we received: 8 sheep, 19 sacks of barley flour, 15 dozen eggs (very few edible), 20 pounds of black Chinese brick tea, 2 trays of vermicelli, 10 goose eggs, 3 sacks of clarified yak butter (in yak skins with hair on) of 12 pounds each, 2 pieces of jade.

On to Lhasa

During our stay in Shigatse numerous references were of course made to Lhasa. While it was not to be denied that Shigatse was a fine city, even its own citizens admitted enthusiastically that Lhasa was the queen of the land. It was naturally with intense excitement that we turned our caravan in that direction.

Our new permit which was necessary to visit this city was received, and read as follows:

"All Dzongpens and Headmen between Gyantse and Lhasa and along the road are all hereby ordered to bear in mind with permission of the Lamas and high officials of the kingdom: American Sahib Cutting and party have started from Gyantse. This passport is granted to the effect that you shall supply on payment without any objection or delay six riding ponies and 15 pack ponies. They should also be supplied, whether it is an intervening stage or a halting place, with fuel for kitchen, birdfruit (eggs), milk, etc., on payment according to prevailing custom.

"Given under the seal of the Tibetan Trade Agent."

We gauged our departure so as to reach Lhasa on an auspicious day, for because it is a holy city to do otherwise might interfere with the welfare not only of the city but of the entire nation. There are good dates and especially good dates, and we consulted the Tibetan almanac to select the best that was feasible.

Beyond Gyantse the plateau shortly rises to over 14,000 feet. Then after crossing two high passes the trail drops way down to the Tsang Po at 11,000 feet. Following this river downstream and up the Kyi Chu, one traverses country of a fairly low altitude. This section is populated, very fertile for agriculture, and all most beautiful indeed.

Practically the only export from the region we traversed is wool, which, however, goes to India in large quantities. From this the natives buy their imports, which are very limited in-

deed. Of metals they use copper, brass, and iron, which are transported on animals' backs. They use also some silver, but practically no gold.

The portion of the plateau over which we traveled is woefully lacking in mineral resources. The late Messrs. Hayden and Cossom recently made a survey, at the request of the late Dalai Lama through the Government of India, over some of the region that we traversed and quite an area of the high country north of Lhasa. But the late Mr. Hayden, who was a trained geologist, could not report the presence of any mineral deposits of any value. Incidentally, he was guaranteed by the government of Tibet a fair payment in rupees in return for his services, but refused the sum, claiming he had been paid many times over by the great interest of his trip.

Mineral resources elsewhere

East of Lhasa is the area the Tibetans call Kam. Here the plateau gently falls as one proceeds eastward toward China and Assam, but in a northeasterly direction the country rises. Little is known of these parts of the plateau, but one can safely assume, since one so very rarely sees the presence of gold in Lhasa even among the rich and since so much metal comes from India, that this country is also lacking in minerals.

A similar condition would seem to exist in far eastern Tibet, the section belonging chiefly to China although containing small independent kingdoms such as Muli and Lolo. The author made a trip through a large part of this country and although a general statement would not be warranted, it can be said that there was very little evidence of mineral wealth, though hardly the dearth of the plateau. Gold, concerning the existence of which in Tibet there has recently been some speculation, did not seem to exist at all.

After being on the trail some days we drew near Lhasa. After the bleak, higher levels, the many areas of emerald green grassland, although swampy, were a lovely sight. Finally a bend in the long valley brought into view the great Potala, seven miles away.

A magnificent spectacle

It was indeed an awe-inspiring sight. Just as Shigatse is dominated by the lamasery of

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KUNBILA PERSONAL ASSISTANT

Tashi Lhunpo, so Lhasa is by the Potala; but of the two the latter is by far the more beautiful. It is indeed devastating to behold; and the spectacle increases in beauty as one approaches. Towering above the city, supreme now and forever, it is possibly the most magnificent building in the world, including the Taj Mahal. Although it has general shape only, with no balance of its component parts, it seems to wear better and better on intimate scrutiny. The most effective point from which to view it is probably the stone causeway which is lined with trees and water. What a building, and by full moon! Its architecture, purely Tibetan, reminds one definitely of no other style. It was begun perhaps in the tenth century, but renovations in the early seventeenth century developed it into what it is today. It could make one dream of ancient Persepolis, for perhaps this is what Darius might have lived in. There is room for much delightful speculation.

Guides had been waiting for us well outside the city, and as guests of the government we were escorted in. The way led past the Potala along a broad street with fine private buildings on the left and a vast open meadow on the right everywhere planted with clumps of willow. In the heart of the city where the bazaar

is located, the streets, most of which are broad, are clean for an eastern city and do not seem nearly as massed with population as in either India or China. The buildings are well constructed, roomy, and with pleasant exteriors.

There is no glass made in Tibet and its transportation by caravan for windows is well-nigh impossible. Laden animals and humans pass here and there, (there is not one wheeled vehicle in the entire country) covered temporary stalls of temporary bazaars line certain streets, with the better permanent shops in the basements of buildings. Nowhere do bad smells, filth, or flies exist—so different are Tibetan cities from the general run of the eastern ones.

Our quarters were located in a perfect spot about two miles from the bazaar and adjoining Norpa Linga, the summer palace and regular residence of the late Dalai Lama. We occupied a small house with stable adjoining set in a huge walled garden of poplars and willows, such as have been planted all about the city.

The population of Lhasa is supposed to be about 40,000 but no census has ever been taken. Of these inhabitants about 16,000 are celebrate lamas who live in great lamaseries of which the two largest are Drepung (meaning a heap of poured rice) with 7500 lamas and

Sera (meaning a heap of hail) somewhat smaller. The inhabitants of Tibet are priest ridden and, in matters of politics and especially the choosing of a new Dalai Lama, the influence of these great lamaseries particularly Drepung, is very strong.

The government of Lhasa is made up as follows: There is a council called the Kashag made up of five—four lay nobles and one Lama, all of middle age or older. This council is a very powerful unit and, constituting the active governing body, it meets once a day. Above these in rank are: the Prime Minister, Si Lon Yapshi Lon Dun, and the Regent, Re-ting Po gya tsap Rimpoche, a reincarnate Lama chosen by the late Dalai Lama before his death. These latter two men, about thirty-five and twenty-five years old respectively, have the highest authority, the latter being able to demote at will any member of the Kashag from his high rank.

The title denoting membership in the Kashag is Shapé. At the time of our arrival the Regent and the senior member of the Kashag, Trimon Shapé, were absent searching for clues that could lead to finding a Rimpoche baby who might prove to be the reincarnation

of the late Dalai Lama. Calling on the remaining officials took up the entire next day. These all, living in the city, had large houses that were usually anything but pretentious from their exteriors but really attractive and comfortable within.

The height of formality

During these visits had come real formality. The scarfs offered here had to be of the very best quality, brand new and both folded and presented in one special way. The presents to each had been sent to Lhasa several weeks before and, of course, were never alluded to.

Beyond our quarters to the westward extended Norpa Linga, the park of the late Dalai Lama, and three summer palaces. These are situated in a huge walled enclosure planted with poplar.

The Potala is the traditional winter palace of the Dalai Lama. But the late Dalai Lama chose to live in three renovated summer palaces exclusively save for one or two weeks in the year. Broad arborescent walks that would be beautiful in any estate in the world criss-cross the park. The residences, surrounded with flower

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KASHAG.

beds and wholly of Tibetan architecture, give one a strange feeling of something perhaps more European than anything one has seen elsewhere in Tibet. Exterior and interior of both, like the grounds, are immaculately clean. There are electric lights (hydro-electric), a Dodge and two Austin cars (the latter brought up in parts)—all entirely disused. There are also large stables and, in one far corner, barracks that housed what was called a regiment of infantry.

No one lives in these houses now except one high lama and at times a sort of major domo of the place who is a noble in gold dress. Both of these were in attendance when we went and entertained us with a most delicious lunch under one of the white awnings.

The rooms in the houses are lavishly decorated with beautiful wall paintings, banners, and fine wood carvings. The furniture is mixed; there is some silk upholstered European furniture of a rather stiffish type, also Tibetan couches along the walls which are used for both sitting and lying on.

On the way out we passed a small artificial pond with a gilded summer house near by where in hottish weather His Holiness (the late Dalai Lama) used to sit and watch his ducks sporting.

Tibetan cuisine

Several lunch parties were held which we attended (Tibetans do not have guests to the evening meal as they go to bed so early). These entertainments were always the same, being long meals of excellent food eaten with chop sticks. The food varies little, usually being first sugared rice, an emblem of good luck, soup with vermicelli cut in strips by hand and tiny bits of tender mutton, small mutton balls or strips of the same with few vegetables, all highly spiced with pepper. For drink, one begins with the everlasting buttered tea and later a native barley beer called *chung*. This contains perhaps one half of one per cent alcohol, as Tibetans are not given to spirits and even rarely smoke, although some cheap cigarettes are beginning to filter in.

Should one be riding in the suburbs or in the city proper, there was always something of

interest. Several times we would come upon Shapés in their gold robes, which is Tibetan full dress of high rank. These would be riding in front of about a dozen of their own people, all mounted. On such occasions, we, like all others, would dismount and doff our hats, to be rewarded with immediate recognition.

Never was there such weather! As it was early October, there was a strong frost every night, but in the mornings a brilliant sun appeared in a cloudless sky and remained with us until it set over the western mountains. So dry was the air that all dampness in the ground, after it had thawed, was rapidly absorbed, leaving a perfect terrain not too dusty.

Finally there came what Arthur Vernay and I thought was an appropriate time to take our departure. As at Shigatse, we had received many presents, so we left cards for officials and friends (this is not a Tibetan custom) and started back over the long trail to India. We knew that late October at over 14,000 feet was unpleasant, with cold temperatures and high winds, and we had plenty of them both.

It is to be hoped the reader will appreciate how exceedingly interesting the unique country of Tibet is. There is definitely no reason to presume the country is opening up. It is not. Tibetans have certainly the right to resent foreigners, yet what a shame it is that their country is not more open.

Most people have looked upon the country as a land shrouded in mystery and quite unknown, but this is hardly true. Much romanticism can be written about it, whether the author has actually been there or not, and the material is more apt to be appreciated than if written about any other country in the world, as the name Tibet bears such an extraordinary lure.

Yet there is still much to be learned of its people and of vast unexplored areas, inhabited or uninhabited. That the people want nothing of the outside world is due to the influence of the priests. This is a country which scarcely knows the existence of the rest of the world. All live their lives in complete ignorance of the outside, and it is fortunate for them that they do, for they are perfectly satisfied, and a healthier or more cheerful lot of people it would be difficult to find.

The Forbidden

[illegible]

(Above)
A letter from
His Highness the
Dalai Lama, written by his
scribe. Long correspondence be-
tween Mr. Cutting and the Dalai Lama
led to an invitation to visit the forbidden city

(Right) Palace-monastery of the Dalai Lama
(Below) The envelope which carried the
above letter



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C. Suydam Cutting Esq.,
32, Nassau Street,
New York City,
U. S. A.





On the trail to Lhasa. The Fort of Penadzong on the shore of "the Lake of the Nomads' Upper Pastures" (Yamdruk Tso). Note the Prayer flags in the water



(Right) Streets in Tibet are broader, cleaner, and less congested than in most other eastern countries. A square in Lhasa



IN THE LAND

(Left) A lama school. Here under the trees near the lamasery of Drepung the students are taught Buddhist text

(Right) The caravan on trail at 14,200 feet between Sikkim and Shigatse, which is the spiritual capital of Tibet and was the expedition's first objective



(Left) A typical courtyard of a Tibetan house where the caravan passed the night. The houses are well built and amply comfortable

OF THE LAMAS

(Right) A halt for tea in a Tibetan home. The people of all ranks are charming, hospitable, and full of good humor





A portion of the bazaar of Shigatse. Situated at 12,800 feet in a huge valley surrounded by mountains, Shigatse is the official residence of the spiritual head of the Buddhist world, the Tashi Lama

Head of the largest Buddha in Tibet. The photograph is taken from a height of thirty feet. The face is of gilded wood



In the great lamasery of Tashi lied to greet the expedition. low hats, the throng milled about visitors but undisturbed by the



Lhunpo, where 3500 lamas gathered wearing maroon coats and yellow hats for half an hour, amused by the notion picture camera



The famous lamasery of Tashi Lhunpo. Its many gilded roofs dominate the landscape



(Left) Exterior of the summer palace of the Tashi Lama at Shigatse



(Left) Private quarters of the Tashi Lama in his summer palace



(Below) Workers in the garden of the summer palace

*(Right) From the fort,
looking across the roofs of
Shigatse*



*(Right) The fort or
Dzong, where the
Civil Governor re-
sides*



*(Below) Regiment in
Shigatse on dress
parade in honor of
the expedition*





PEOPLES

(Left) Rakyabars, disposers of the dead



Beggar women of Shigatse



High Lamas, Drepung Lamasery

Professional dancers, Lhasa



A famous painter of Lhasa



OF TIBET

(Right) A family of high degree



Lama police in Drepung



Noble ladies from Shigatse and Lhasa



Northwest entrance to Lhasa. Being a holy city, the expedition consulted the Tibetan almanac and

(Right) Looking over the roofs of Lhasa toward the Potala



(Below) Guards at the entrance to the Dalai Lama's summer palace. The uniforms and rifles are from India





it can be entered only on a lucky day. The expedition planned their arrival accordingly



(Left) An avenue in the summer estate of the Dalai Lama at Lhasa

(Below) The expedition's headquarters in the forbidden city, a comfortable house in an enclosure of poplars and willows





PALACE-MONASTERY



(Top) The famous Potala. A building seen by few explorers, but one of the most beautiful structures in the world

(Right) A stairway leading to the section of the Potala which is the official winter palace of the supreme ruler of Tibet. The enclosed courtyard shown directly above is on the very top of the building



F THE DALAI LAMA

(Above) A lower stairway of the Potala

(Right) An impressive building in all its majesty and mystery. The Potala was begun perhaps in the tenth century, but renovations in the early seventeenth made it what it is today





Tibetan coracles on the Tsang Po (Brahmaputra) River which conveyed the expedition ten miles down stream



(Center) Yaks grazing on the shore of Yamdrock Tso, "the Lake of the Nomads' Upper Pastures"



(Left) A young groom who tended Mr. Cutting's horse during a halt

Bird Voices in the Southland

Making "talkies" with an all star cast of native American birds

By ALBERT R. BRAND

*Associate in Ornithology,
American Museum of Natural History*

PHOTOGRAPHS BY ARTHUR A. ALLEN, P. PAUL
KELLOGG, AND JAMES S. TANNER

*Magellan braved all seas that roll,
Commander Peary found the Pole,
Leander swam the Hellespont,
But I have tramped across Vermont.*

THUS did Arthur Guiterman sing of the explorer who stays at home. Strange as it may seem, it is not always necessary to travel great distances to foreign lands to bring back interesting and valuable results. Right here in the United States there are treasures to be sought; treasures that in a few years may be past obtaining. The frontier is gone, but even today there are areas of no inconsiderable magnitude practically unexplored; and one need not even go so far as our newer west, for, though they are becoming scarce, little-explored regions still exist on the Atlantic seaboard and in the Mississippi Valley.

In February, 1935, a joint expedition of the American Museum of Natural History and Cornell University set out on such an intramural undertaking. The object: photographing native wild birds and recording their voices. Particular attention was given to species that, because of the fast development of civilization or for other reasons, are becoming rare.

Dr. Arthur A. Allen, professor of ornithology at Cornell University, led the party, his special province being bird photography, both still and motion pictures; he also directed the ornithological observations, and arranged the itinerary; the writer, whose major interest for several years past has been recording sounds of native birds, accompanied the group on the journey into the southland; Paul Kellogg, in-

structor of ornithology at Cornell, was the technical expert in charge of sound recording; Dr. George M. Sutton, a distinguished bird artist and curator of birds at Cornell University, joined the party in Florida and Louisiana, and contributed a number of water color sketches of the rarer and more unusual species; and lastly, James S. Tanner, a graduate student, accompanied the expedition as camera-man assistant, sound recording helper, cook, and general handy man.

The sound equipment

One bleak morning in mid-February, two small Ford trucks loaded with cameras, sound recording paraphernalia, and camping equipment pulled out of Ithaca, New York, headed southward.

The trucks, besides transporting the party, served two other purposes. They sheltered the men for at least half the time afield, and proved that one can rest quite as comfortably in a truck as one can, let us say, in the more conventional Pullman berth. In addition, one Ford was especially adapted for sound recording. In it were mounted amplifiers, sound cameras, and several hundred feet of cable with which to connect the microphone in the field and the equipment in the truck; also this vehicle carried the sound mirror and its tripod.

The sound mirror or reflector is a large circular disc—a section of a parabolic curve—some three feet in diameter. At the focal point of the parabola the microphone is set. The result: when the combined microphone and parabola is focused upon a singing bird, the song is greatly amplified. All other sounds not directly in the beam, however, reach the microphone in only normal volume. The object of this device is to reduce outside or ground noises, which frequently ruin otherwise excellent out-

door recordings. The mechanical ear, as the combined microphone and parabola has been called, is set on a tripod, and hooked up to the amplifier and sound camera in the truck. Most of the recordings are made using the microphone in combination with the parabolic reflector, but occasionally it is expedient to use the microphone alone.

On the prairies of Florida a six-foot diamond-back rattler was encountered. In this case the microphone was dropped close to the subject—closer no doubt than the recorder would have dared to be himself—and the snake rattled directly into the recording device; and again in a heronry in Louisiana the microphone was set among the nesting birds, and the various raucous honks, rattling croaks, and peculiar squawks were faithfully recorded.

The photographic equipment

The second truck was used for photography. The Akeley camera and its substantial tripod, kindly loaned for the duration of the expedition by Mr. Duncan H. Read, was most useful and brought beautiful results; but it was a bulky affair, requiring much room, and was no joy to lug a half mile or more through virgin forest and swamp. In addition, there were several other moving picture and "still" cameras. The roof of this truck was fitted with a collapsible platform or tower, similar to those used on public service corporation repair trucks; and often the photographer stood his camera on the top of the truck, and did his "shooting" from there. Occasionally, when we were photographing birds that nested well up in the trees, the roof was not sufficiently high; then the platform was extended to its full height. This enabled the camera-man to operate from a point about twenty feet above the ground.

Outfitted in this manner the group was ready for a powderless hunt, where camera and film supplanted rifle and shot. The trophies were not to be bird skins, for the expedition was interested in preserving, not decimating, the rare species that are already all too near extinction.

It might be well to consider for a minute what we mean by rare birds. The term "vanishing birds" hardly needs explanation; generally it refers to those species that once were plentiful, but for certain reasons, persecution or hunting or what not, are now on the point of extinction. Every so often we hear of such cases. The wild turkey has all but vanished from a

large part of its former range, and the final disappearance of the last lone heath hen in Martha's Vineyard, little more than a year ago, reminds us that, do what we will, if a form becomes exceedingly scarce, all our powers are futile. Protection is of no avail. Fortunately those interesting and beautiful birds, the white herons or egrets, which were becoming extremely rare a generation ago, are again abundant.

One of the most outstanding examples of what one individual can do for the preservation of birds is Mr. E. A. McIlhenny's "Bird City." He has made an artificial pond on his estate so attractive for snowy egrets that, from a small beginning, the birds have now increased to more than 10,000. Through Mr. McIlhenny's courtesy and hospitality the expedition was able to record the curious calls of these birds, and to secure many excellent photographs.

It is to the credit of such individuals as Mr. McIlhenny and of the National Association of Audubon Societies and other conservation groups that these interesting birds are alive today. Through their efforts the birds have been saved for posterity. Not so with the passenger pigeons, however. Hardly a hundred years ago flocks were encountered so large that they literally darkened the skies. The last known specimen of this beautiful bird succumbed in captivity in 1914. Over-hunting—the bird was large, unwary, and toothsome—brought about its destruction; and almost before most people were aware that the species was getting rare it had vanished from the face of the earth.

Rare camera subjects

But what about rare though not necessarily vanishing species? Not all rarely seen birds are on the verge of extinction. There are, we are glad to say, comparatively few forms that are actually close to the border line; but, on the other hand, there are many birds that are commonly called rare. Rareness of a bird often depends upon the locality of the observer. Birds that are very rare in one place, if followed to their breeding grounds may well be as common as English sparrows at home. Others, if not common, are at least of usual occurrence.

Consider for instance Audubon's caracara, a vulture-like hawk, which though common in Mexico and to the south, is found only in a few favorable localities in our southern states. On the Kissimmee Prairie of Central Florida the

bird is a common resident, however, and it was not difficult to find nesting birds. This region, perhaps eighty miles long by forty wide, is practically uninhabited. The only signs of civilization are occasional herds of scrawny cattle that eke out a meager existence on the sparse prairie grasses.

The trucks were driven over the pathless wastes to a hammock—a prairie oasis, where a few hardwood trees and cabbage palms manage to exist on the comparatively dry, sandy soil. There, in a large cabbage palm, twenty or more feet from the ground, a pair of caracaras had built their bulky nest. It sheltered two nestlings almost ready to fly; and when a member of the party donned climbing irons and shinnied up the tree, one of the young birds fluttered out. Then followed a chase through scrub palmetto; but the bird was finally captured and induced to pose before the camera. Eventually it was returned to the nest. On this occasion the collapsible tower was most useful, for when extended, the photographer was enabled to work within ten feet of the nest.

Some of the larger birds

Another bird, not uncommon on the prairie, is the Florida or sandhill crane. These large birds are true cranes, not herons; the wing spread is six or seven feet, and when standing erect their height is equal to that of a ten-year-old child. Nervous and wary as they are, photographing them was a matter requiring consummate patience and skill. The voice can be described as a loud trumpeting, rather musical and startling. Toward evening and at dawn these mighty birds fly over, trumpeting as they go. There is something awesome about their loud voices ringing over the otherwise hushed prairie; the peculiar light, the unending, flat, rolling seas of grass and palmetto, give one a feeling of reverence in the presence of powers far greater than those of insignificant man. But the sound recorder has little time for such thoughts; he must be alive to his opportunities. It was at such a time, with the prairie bathed in eerie sunlight and the cranes trumpeting overhead, that the loud stentorian calls were recorded.

Persecution has made the bald eagle a rare species in all but a few of its former haunts. At one time this bird, our national emblem, was common over most of its range. Its great size made it an easy target and, although rarely

destructive, it receives protection in less than two thirds of our states. Fortunately on the coast of Florida, eagles are still fairly common, and it was on the east coast that the expedition secured photographs of these spectacular birds.

Wild turkeys also are large birds, and in addition, furnish excellent food. They have all but disappeared except in the wildest and most inaccessible regions; their future is indeed precarious. However, in Georgia, thanks to the coöperation of Mr. Herbert L. Stoddard and Col. L. H. Thompson, a flock was baited up before a blind, and sound and pictures of both male and female birds were secured.

Free from the fear of man

However, there is another side to the picture, and, in certain parts of Florida, birds that are generally credited with being wary and shy, have, to a large degree, lost their fear of man. In central Florida, in the heart of the city of Orlando, is a small lake. Here scaup and ring-billed ducks, coots, cormorants, and gulls congregate during the winter season. The ducks arrive in the autumn, after having migrated from their northern nesting ground. On their journey southward they are subjected to a constant barrage of lead; and on arriving at winter quarters, one would expect them to be cautious itself; yet that is not so; they seem to sense that they are protected on this city lake. Here the park attendant feeds them daily, and they have become so tame that they will take food out of his hand. The residents also feed the birds, and it is really amazing to see these usually wary creatures with apparently no fear of their arch enemy, man. Hold a piece of bread in your hand above your head, and gulls will fight for the privilege of grasping it from between your fingers; while coots and ducks will churn the water at your feet in their attempts to get you to hand them a titbit.

At St. Petersburg, on the gulf coast, conditions were similar, and several species of gulls and ducks partook of the festivities. In addition, the brown pelicans have become so tame that on the municipal pier it is not uncommon to see a number of these comical, ungainly birds standing next to the fishermen patiently awaiting a handout. If a fish is caught too small for the fishermen's creel, it is deposited in the waiting pouch of an attendant bird. It was not difficult to get the pelicans to pose for their pictures. A can of live bait, bought on the pier and fed

to the birds by the hand to mouth method, lasted but a short time. The sound apparatus could not be used, however; pelicans are one of the few voiceless birds, almost as silent as that silent mammal, the giraffe.

Recording the ivory-bills

The most protracted stay was made in the country of the ivory-billed woodpecker. This, the largest native woodpecker, is a truly glorious bird. Slightly larger than a crow and almost as black, the ivory-billed is much more unusual and startling in appearance, especially if seen on a tree trunk as it works in typical woodpecker fashion. Both sexes have prominent crests; that of the male is a flaring red; the female's is black. When the bird is at rest, great white patches on the wings suggesting white coat tails sharply contrasted against the greenish black of the rest of the body are strikingly prominent. The large bill is ivory-colored, as the name suggests. The species has always been uncommon; of late years it has become so rare that it is on the verge of extinction.

Ivory-bills were sought in several Florida regions, and much time and energy was expended running down every clue and rumor. Professor Allen had observed the bird ten years previously in one of the wilder regions of central Florida; and a local observer reported having seen an individual in the identical region no longer ago than the preceding Christmas. However, sight records of this bird must be taken with caution, for the other large native woodpecker, the pileated, inhabits similar regions. Confusion is all too common, and a trained observer and close observation are necessary for positive identification. Many of the casual reports of ivory-billed no doubt refer to pileated. Nevertheless there seems to be good reason to believe that a few ivory-bills still inhabit the Florida region; but actual specimens were not seen.

In a dense southern swamp, however, the birds are making their last stand. The large waste area is in private hands, but the birds, fortunately, are receiving the protection they so sorely need; and even visiting the region is discouraged. In fact, the expedition spent a full day of valuable time on the long distance 'phone and telegraphing, before permission was granted to enter.

The warden, J. J. Kuhn, acted as guide; he is guarding the birds' last stand and, with-

out his aid, finding the birds would have been well nigh impossible. But the difficulties were not over, even with the granting of permission to enter, and with the enlisting of Warden Kuhn's aid. Miles of virgin swamp and partly submerged lands had to be navigated. As means for transporting the sound equipment and cameras, the trucks were useless; and an old farm wagon and four mules were pressed into service.

After much searching, a pair of ivory-bills was eventually located. Here, twelve miles in, camp was pitched, and for a week or more, notes were taken, photographs made, and sound recorded of America's rarest bird. Almost exactly a hundred years ago Audubon studied this bird in the same region. It was rare in his time; little careful work had been done since, and many facts of the life cycle of the bird remain unknown. All during the daylight hours, from a distance of about seventy feet, a twenty-four-power telescope was focused on the nesting hole and careful observations were recorded. One or another of the group was on duty with the telescope during the entire stay.

Will the ivory-bill survive, or like the Carolina parakeet, the only native parrot, and the passenger pigeon, is it also doomed? Time alone will tell; but "while there is life there's hope," for several species that had almost disappeared, with changed conditions have later revived. It seems apparent that ivory-bills are having difficulty in bringing their nesting activities to a satisfactory conclusion; and, of course, there is no hope for a species that cannot raise progeny. As yet we do not know the exact cause of nest destruction, but the days of continued study and recording were fruitful, and furnished several clues as to what is causing the decrease. If the causes can be established definitely, it may be possible so to control them that this most interesting form, now almost extinct, can be saved for posterity.

Instead of the skins of birds, more than fifty thousand feet of film—twenty thousand feet of sound, and thirty thousand feet of motion pictures—were taken from the field, to be preserved for future study. It is hoped that the rarer birds may be saved for the benefit of future generations: if that is impossible, at least we shall have pictorial records of them; we shall know what their vocal attainments were—a poor compromise at best—but far superior to a record consisting of only written words.



These laughing gulls were unusually tame, as are many Florida birds. The northern visitors feed them. A minnow thrown into the air in front of the photographer made this picture possible. The minnow never reached the ground

Bird Voices in the Southland



THE IVORY- BILL

The ivory-billed woodpecker, one of the last of his kind, poses for his portrait. This bird, the rarest in the United States, is larger than a crow. Why he is so nearly extinct is a puzzle. The data accumulated on the expedition may throw some light on the subject

(Right) To transport the delicate sound-recording apparatus into the ivory-bills' country it was necessary to dismantle the automobile sound truck. The apparatus was transported through the swamp in a farm wagon and re-assembled at camp. Mr. Kellogg, during a take, carefully keeps record in a notebook, as well as on sensitized film



The mechanical ear, in a swamp in the deep South, recording the sounds of the ivory-bill. The microphone is set at the focus of the parabolic disc, and the apparatus is then centered on the bird. This device greatly amplifies the desired sound

GOES ON RECORD



(Left) Professor Allen studies the ivory-bills. Continuous observations were made for five days; one or another member of the expedition watched the nesting hole through the twenty-four-power telescope during all daylight hours and kept a log of the birds' activities



(Left) Wild turkeys are still to be found in sections of the South, though they are scarce everywhere and much in need of protection

(Left Center) A limpkin watches from the opposite shore as one of the party climbs to the nest. The bird is oblivious of the fact that it is being photographed from behind



(Lower Left) Lesser scaup ducks spend the winter season in a lake in the heart of the city of Orlando, Florida. Many other residents of the North do likewise. Protection and feeding have made the birds so tame that they will come almost within reach if offered a little bread

ON LAND

ON WATER

IN THE AIR





(Above) A quizzical old pelican flaps past at close range. Beautiful he is not, but graceful and admirably adapted for his special mode of life



(Upper Right) The ospreys or fish hawks make a huge nest which they inhabit year after year, adding to it and repairing it from time to time. Fine recordings of their voices were obtained



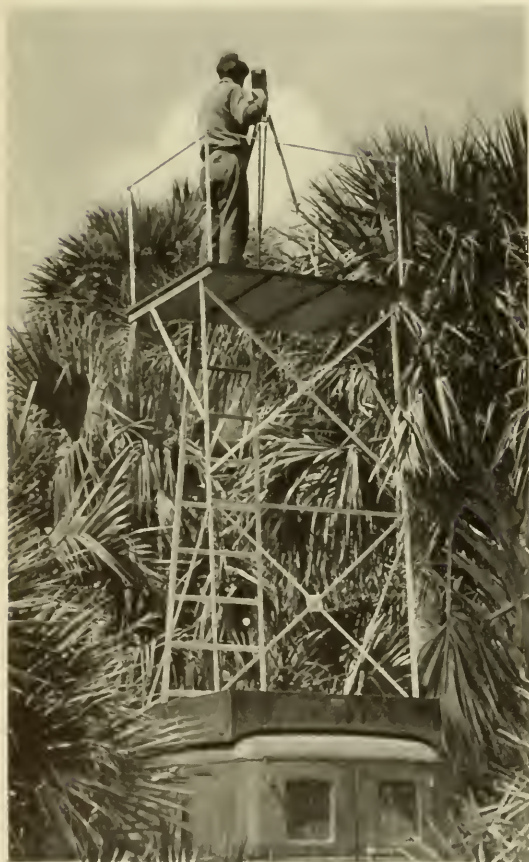
(Lower Right) In order to listen in on a little snowy heron gossip, the operators set the microphone among the nesting birds. Excellent recordings of their peculiar squawks and honks were made which, though faithful, are anything but lovely. Herons should be seen, not heard



(Left) On Gandy Bridge between Tampa and St. Petersburg, Florida. Pelicans benefit from the sun's rays. At rest and close at hand these birds look most ungainly, but in flight and when diving, they are grace personified



(Above) The wood ibis is becoming extremely rare, and the expedition considered itself fortunate to come upon this rather large flock of these ungainly birds



(Left) Here Mr. Kellogg is using the collapsible tower on the truck as a point of vantage in photographing Audubon's caracara

(Below) The loud speaker was set in the territory of this mockingbird, and film of an earlier recorded mocker was played. The bird seemed quite upset; a loud speaker rival was a new experience



(Right) *A Florida diamond-backed rattler poses for camera and "mike"*



(Below) *A Louisiana heron swain presents his lady love with a twig. During the whole period of incubation and even after the young are hatched, the old birds continue to bring nesting material to enlarge and improve the nest*





(Above) The Kissimmee Prairie from one of its hammocks—home of the Florida sandhill crane, Audubon's caracara, vultures, American egrets, and many smaller and less rare birds



(Above) Thirty feet up in the top of a cabbage palm was a caracara's nest containing two nestlings almost ready to fly



(Left) The young caracara hopped out of its nest when one of the expedition party approached too close. The bird was pursued through the scrubby palmetto undergrowth and finally "induced to pose before the camera"

On Safari in America

A woman's story of a dinosaur hunt in the wilds of her native land

By MRS. BARNUM BROWN

SEEING America last has opened up horizons in my native land that the ordinary traveler or stay-at-home little dreams exist. Sometimes the farthest mountain shines the brightest, and the moon in Mandalay may seem the softest, but here within our reach are scattered scenes of beauty to be had for the seeking. A safari in America can offer as many thrills as one in any other part of the world.

Sometimes the Hunter and I followed the elusive trail of the dinosaurs with pack and saddle, pitching our tents beneath the stars, along the old "hoss" trails of the golden west.

Again we rambled by motor through the flaming glory of the Grand Canyon, the soft pastels of the Painted Desert, or the shadowy beauty of the Black Hills.

Today finds us hunting "dinos" with a Stinson plane, covering in one week the horse and motor journeys of an entire year. The methods vary, but the end's the same—bigger and better dinosaurs for the American Museum.

Short scouting trips can yield rich treasures, dinosaurically speaking, and several of our prospecting parties consisted of just three: Doctor Brown, his assistant, and myself. The first two were the prospectors, while I constituted the party.

A rare find

One day the dinosaur hunters returned to camp with the glad news that they had found a rare carnivorous dino, which might have been cause for alarm, save for the fact that his flesh-eating days had been numbered some hundred million years or more ago.

On Beauvais Creek, in the Crow Indian country, the pursuers found a new, low-plated

dinosaur, the only one with a skull known from this age. Day by day the solid sandstone hill was chipped away from the skeleton, until another strange beast came to light—a huge, horned-toad-like creature that resembled the modern lizards of today.

A kangaroo-shaped freak, with long hind legs, short front ones, very long tail, and duck-like beak, also fell to the lot of the dino hunters on this trip, and this, together with the "Dread-naught," joined the parade of queer animals headed for the halls of the Museum. And the Hunter's name is Barnum.

Wanderers

"Where my caravan is resting" could not be sung of these short trips, because we seldom stayed more than a day or two in one place, and camp equipment for these one-night stands must vary with the individual. There are, however, three items of great help to the wanderer. They may be found everywhere, and do not constitute excess baggage. These are tolerance, love of beauty, and a sense of humor. With these three requisites in the old kit bag, one can journey to the ends of the earth.

While the Doctor is in the field hunting big game of other days, my hours are filled from sun-up till sun-down; for a woman in camp must often play the various rôles of secretary, photographer, cook, camp-wrangler, as well as wife. Perhaps the most important is the secretary's job, for camp records must be kept to date, as an impression once lost is difficult to remember accurately.

Domestic duties vary with the expedition, as does the camp menu, which usually consists of the all inclusive American can, and a side of ham or bacon, mixed with a generous supply of creative instinct, cooked on a gasolene stove,

and served with a dash of imagination. Again the methods vary, but the end's the same—ham and—

On large expeditions where we have a cook, I still must plan the meals, keep records, and manage supplies, which is sometimes more complex than doing things myself.

Along camp trails

Since I cast my lot with the Dinosaur Hunter, we have pitched our tents on far-flung trails—in distant India, Burma, Egypt; on the golden Isles of Greece. Wherever the ghosts of the dinosaurs have beckoned, I have tramped along with the Hunter, and I learned about camp life from him. Camps may come, and camps may go, but the expedition must go on, despite personal vicissitudes and discomforts.

Along American trails there are conveniences not to be found in foreign lands, except perhaps in India, where the spacious government (dak) bungalows vie with our tourist camps. Our camps are more numerous and elaborate, however, and the weary wayfarer gladly seeks these havens of rest, where the hardships of setting up tents at night fade into dreams in a comfortable bed, with bath.

The most beautiful camps I found in the Black Hills of South Dakota, where we spent several days searching for dinosaurs near the classic ground where later roamed the great titanothere, the saber-tooth tiger, and the three-toed horse, their bones now turned to stone, entombed in solid rock.

One night my cabin nestled in the trees, where the night wind, murmuring through the pines, mingled with the quavering notes of the poor-will.

Another night was spent on the banks of beautiful Sylvan Lake, a gem of crystal water, where the moon sank to sleep in silvery splendor on the soft bosom of the lake, guarded by the stern sentinels of Needle Rocks.

Around a bend in the road one is suddenly startled by a face silhouetted against the clouds, and the colossal head of Washington gazes serenely over the trees from the granite top of Mount Rushmore. By his side are Jefferson, Lincoln, and Theodore Roosevelt, with heads sixty feet from crown to chin. This gigantic memorial is one of the greatest sculptures of all time, exceeding in size the famous sphinx of Egypt—an inspiring monument to America's

ideals of life, liberty, and the pursuit of happiness.

The Black Hills, in the heart of the west, form a little mountain kingdom, within whose pine forests may be found surpassing beauties of nature. Here the wondering tourist may explore to his heart's content along roads that wind through towering granite walls and woody canyons; petrified forests; hot springs; and subterranean labyrinths that burrow hundreds of feet beneath the earth.

The most fascinating of these underground wonderlands is Wind Cave.

Long ago in the eighties, a hunter, stalking deer, heard the wind roaring on a still day, and traced the sound to a hole in the rock where the wind was rushing out, blowing the grass in all directions. Most people thought his story was imagination, but he finally interested another man, and together they sank a shaft into the cave, and with ropes and torches they explored several miles of passages, later opening up the wonders to tourists.

As one descends, the cavern opens into a labyrinth of passages lined with shining crystals of various forms and color; some of these passages are so narrow that one has to squeeze through; others are of huge dimensions like cathedral halls.

Crystal fairylands

In "The Queen's Drawing Room," festoons of crystal draperies adorn the walls, hanging in shimmering folds from the ceiling, while the floor is carpeted with opalescent gems. "The Garden of Eden" is a maze of shining light, where trees, and flowers, and frozen dewdrops glitter like sparkling jewels. Foamy white crystals, like summer clouds, adorn the walls of a secret passage known as "The Pearly Gates," as though one had suddenly awakened in the heaven of imagination.

In this wondrous cave, now a National Monument, one can wander through a hundred miles of crystal fairyland, entombed beneath the surface of the earth.

Surrounding the Black Hills are rocks formed in ocean beds of long ago, where we found the remains of a swimming reptile, or prehistoric sea serpent, whose twenty feet of serpentine body once glided through the waters of an ancient sea.

As we leave the beautiful Black Hill country, a pillar of volcanic rock, known as "The

Devil's Tower" is seen for many miles, rising like a monument to forgotten time. Geologists tell us it was a volcanic plug that was pushed upward and cooled, forming a basaltic column while still under cover.

But the Sioux Indians have a different explanation. According to their legend, two Indian children were chased by a bear. To save them, the Great Spirit pushed the earth up where they stood, and as the column rose, the bear left claw marks on the sides of this pillar of rock.

Contrary to popular opinion, the dinosaurs which we search were not all large creatures. One of the smallest known was located in this region—a pygmy no larger than a hen turkey, with a huge head, and dagger-like teeth; probably a small tyrant of those early days before the dawn of human kind.

Our caravan rolls on, until one day, on a lonely hillside in Wyoming, when the purple haze of evening is veiling the valley, we come upon an unknown burial ground of the dinosaurs, where thousands of bones are crossed and crisscrossed in a common grave; those of mighty monarchs fifty feet in length mingled in death with others of more lowly size. Thus was discovered the Howe Quarry, second in size only to the great Dinosaur National Monument at Vernal, Utah.

The Howe Quarry

In 1934 the Sinclair Refining Company championed the cause of the dinosaurs by financing the American Museum-Sinclair Expedition, and the first crew left for the Howe Quarry in April to start uncovering the bone yard.

Tent City was aptly called "Dinosaur Camp," where a handful of tents, clustered together in a little green valley, sheltered the personnel of the expedition. Some called it "Question-mark Canyon," possibly because of the eternal queries that hovered about like wraiths over the dear departed.

Old-fashioned education depended on one's knowledge of the three R's, but our experience in the dinosaur quarry led us to believe it should be the three H's. "How big were the dinosaurs?" "How long ago did they live?" and "How did they come to die out?" The hills must still echo with the many answers.

Camp was never lonely, because news of the great discovery had been broadcast by one Hans

Adamson, the expedition publicist. Verily, hundreds of visitors came from all parts of the United States, and some from Europe, to stare, and question, or sit for hours on the bank watching the preparation of this wonderful mass of bones.

A woman's work

My days were divided between conferences with the cook and doing the secretarial work, which in itself was a full time job, and occupied most of my time. Replies must be sent to hundreds of letters, for it seemed as though everyone had suddenly discovered a skeleton in his closet that demanded investigation. The specimens included a petrified flapper's foot, an Indian moccasin turned to stone, fossil snakes and flying fish, as well as numbers of supposed dinosaur eggs.

The letters were sometimes followed by hurry calls for the Doctor, who would jump into his car at the earliest opportunity, and dash perhaps a hundred miles to the scene of the discovery—only to find a distorted rock, or the skeleton of some old horse or cow.

My spare moments (if any) were spent in the quarry, where I could watch, as never before, the complete story of the preparation of dinosaurs from the time they are unearthed until they are exhibited in the Museum.

So delicate is the work after the bones are uncovered, that the final cleaning is done with small paint brushes and awls, after which the uppermost bones are shellacked and hardened to keep them from breaking.

The blocks are then braced with wooden splints, and covered with strips of burlap that have been soaked in plaster. When this hardens, the entire block is turned over, and the same process applied to the other side; thus, when it is ready for shipment, the whole specimen is encased in a protective cast.

Before the bones are removed, the entire collection is elaborately charted, sketched, and numbered, so that when the bones are unpacked, they can be definitely placed in their exact relationship as they were found in the quarry, and parts of detached animals can be associated. Some of these blocks weigh one thousand pounds.

Socially we are the pets of the neighborhood, and make ourselves at home on all the "dude" ranches. Nearest to us, in beautiful Shell Canyon, is the Quarter-Circle Ranch, the spacious

home of Bill and Rowena Paton, where "dudes" can live in ease and comfort despite their riding togs.

Camp news

Dippings from the "Dino Digest," our camp news bulletin, give some account of daily topics of interest.

"August 12 was a gala day in camp, when President Davison honored us with a visit. Even the bones were on their best behavior, and showed off very well in their new coats of shellac, and plaster of Paris jackets.

"Young Trubee Davison was so thrilled by the daily doings of Dino Camp that he would gladly have stayed and helped in the quarry."

"Dinosaur and Dinorette (the Browns to you) attended the Old Time Picnic at Hyattville, where the whole country-side turned out, well equipped with lunches. The Doctor and wife were called upon for speeches, which were summed up in the local paper as follows: 'Doctor Brown gave a very interesting talk on his work. His daughter gave a short talk on foreign affairs.' The speeches were followed by acrobatic stunts, and solos, until the saxophone player tooted the final horn. A good time was had by all."

"Carl, assistant manager, had a surprise birthday party. The cake was a delicious sawdust and excelsior 'layer,' with plaster icing. 'Happy Birthday,' in raisins, put the finishing touch to the chef's masterpiece."

"Flash! Fuzzie, our mascot (suspected cross between a sheep dog and a porcupine) presented the camp with quinpuplets. Mother and quins are doing well."

In the early evenings, by way of diversion, the Hunter and I stroll up to the quarry to rest on the bank overlooking the "dinos."

It is easy to roll back the curtain of time 140,000,000 years, to the days when these creatures lived, fought, and died in the shallow

lakes that dotted the verdant valley. Heroes or villains of their day, here they were lying together in their last round-up.

This is the spot we love the most at the close of day. The hills are beautiful in the twilight, fading from gold to rose, and into the purple dusk of night. A million stars are in the heavens when we stumble down to our camp beds.

One day Ma, our trusty cook, poked her head out of the tent and cried, "We're snowed in!" We were. For three days and nights the blizzard howled, and when it was at its height, two horsemen appeared on the horizon bearing the sad news that Ma's son-in-law had met with a fatal accident, and she must leave at once. She did. Clad as she was in her blue overalls and leather jacket, her feet encased in gunny sacks to keep them from freezing, she looked like a Chinese refugee; while I, left alone, felt like one. Alone indeed, for the Hunter was flying somewhere up in the blue, on the first lap of his aerial expedition, and I was alone to keep camp for the men.

The gumbo ridge road to our camp when wet was impassable, and the time I was snowbound in Canyon Camp can only be outdone by the time I was rainbound in the selfsame place—another adventure in my life with the Dinosaur Hunter.

The end of the flight

After six weeks the expedition plane, like a weary bird, sank down to earth again, and the flyers returned to camp to help finish work in the quarry.

They had ended a hazardous flight of 20,000 miles over the mountains, canyons, and Badlands of seven states. They had blazed a new trail of dinosaurs from the air.

So passed the days on the old camp ground.

Many have asked which country holds most thrills for the Dinosaur Hunter. For romance, beauty, and adventure, give me a safari in America.



"Dinosaur Camp" in a clump of cottonwood trees a stone's throw from the Howe quarry near Shell, Wyoming—the only approach a perilous drive over the rim of the hills

On Safari in America

(Right) The Browns start on a dinosaur hunt in the expedition's Ford truck

(Center) Anxious moments in camp. Ted Lewis gives "first aid" to Ma Denniger



(Left) Busy moments for the camp secretary. Mrs. Brown kept the camp records, an important job, in addition to her many other duties



(Upper picture) The dangers of dinosaur hunting. In a hazardous location on a steep hillside in the Painted Desert of Arizona the hunters excavate a rare crocodile-like skeleton previously unknown in America

(Lower picture) The sandstone wall near Vernal, Utah, where various museums removed several carloads of dinosaur skeletons. Here the Government Commission is planning the Great Dinosaur National Monument



Personal instruction in the Dinosaur Quarry. Mrs. Brown learns from the Dinosaur Hunter how to clean skeletons—and still live. No one unfamiliar with dinosaur hunters and their regard for fossil bones can appreciate the extreme

care and reverence with which they handle their precious finds. Everything must remain as discovered until it can be studied and prepared, and no one dare remove a broken fragment, for it might be important



(Above) Distinguished visitors in camp. From left to right are Mrs. Shea, Mrs. Brown, President Davison, Mr. Lewis, Mr. Shea, Trubee Davison, Jr., Doctor Brown, and Fuzzie, camp mascot

In Camp

(Left) Mr. Bird collects a cowboy outfit from Mrs. Paton, owner of the popular "dude" ranch near Shell, Wyoming

September Snow

(Right) A September blizzard cripples Dinosaur Camp, and delays work in the quarry



(Left) An important event in camp life. A clanging cow bell calls visitors and crew to meals beneath the shady cottonwood trees

(Below) After the storm the men are kept busy repairing the tents





Photograph by Maude Shea

Along the Way

(Above) Majestic peaks of the Grand Teton Mountains, bordering Yellowstone Park

(Left) These weird, fantastic Badlands are the graves of ancient creatures that long since have ceased to roam

(Below) The Grand Canyon near Bright Angel Trail, Arizona



How About the Tent Caterpillar?

An illustration of the Balance of Nature. To what extent is it wise for Man to interfere?

By FRANK E. LUTZ

*Curator, Department of Entomology,
American Museum*

IN THE vicinity of New York City the year 1935 was a tent caterpillar year. What that meant for the office force of our department of insect life only those can know who have been at the receiving end of letters, telephone calls, and visits about some insect that has aroused public interest.

It would have been much easier for us if we had been willing to give the simple old advice: burn the caterpillars in their webs and, when winter comes, collect and burn the egg-masses. In fact, not knowing any better, that was the advice we gave, say, fifteen years ago. Since then our doubts about its wisdom have been growing until now we venture to say: "Kill, if you wish, the tent caterpillars on your orchard trees and ornamentals but let Nature take care of the wild trees and *by no means cut down wild cherries*." This called for patient and repeated explaining. Let me try once again, this time in print.

"Balance of Nature"

The tent caterpillar, *Malacosoma americana*, is a native American insect and this fact has an important bearing on the question of what to do about it. If we were considering a foreign insect that, like the Japanese beetle, has been recently introduced without its natural checks, the story would be quite different. But the tent caterpillar has been here for hundreds of thousands—possibly millions—of years; and long before garden clubs and Scouts were organized, or ever man took thought of managing out-of-doors, Nature herself had so arranged things

that both the tent caterpillar and natural vegetation, including wild cherries, can live together. The tent caterpillar has been bound by a "Balance of Nature" between it and its environment, including its diseases and insect enemies, in such a way that in any given district the years of caterpillar abundance have been followed by years of scarcity with astounding regularity. If recent organized human interference with natural processes has not thrown the balance out of adjustment, the New York regions that had a peak of abundance of tent caterpillars in 1935 will soon have a scarcity of them for several years. On the other hand, if the balance has been disturbed—well, the result will be interesting scientifically but possibly not pleasing to the wayside committees of garden clubs. When Man interferes with Nature's biological set-up, he is very apt to make a mess of it.

Interference risky

Of course it is true that human civilization necessarily interferes with Nature. The first settlement of white men in America started a whole series of changes in American out-of-doors and the more the country is built up the less "natural" it will be. However, although it seems necessary that we interfere, it is certainly not wise to act blindly or to go too far. The cutting down of wild cherries, the normal food of tent caterpillars, is a case in point.

It has been rather clearly shown by recent work in Europe that when a leaf-feeding species is deprived for several generations of its normal food and is reared on the leaves of some other plant, it will adopt the new food as "normal" and will not go back to the old kind of food

except under compulsion. Adult females of the tent caterpillar now place their eggs almost exclusively on wild cherry, but a small percentage lay on apple and related plants, more rarely on unrelated ones. Now, if the moths find no or few wild cherries, all or most of their eggs will be laid on apple and related plants and many will be laid on other kinds of trees. In some not clearly understood way a preference for the new food-plants would almost certainly be passed on to succeeding generations and the result would be that Man's misguided actions would have changed the tent caterpillar from largely an eater of wild cherry leaves to an eater of other leaves, particularly of apple and related plants.

Wild cherries are safe

Man would have "burned down the barn to get rid of the rats only to find that the rats had moved into the house." Not only is this true of the tent caterpillar, but it is true also of scores of other species of wild cherry insects that, if it were not for the wild cherry, might conceivably become feeders on other trees.

Furthermore, many people want the "barn." Therefore, when I have told these people that the tent caterpillar is not as yet a really injurious species, partly because it so largely confines its attention to wild cherry, I have been asked why I place no value on wild cherry. I do. I regret that my own yard is too small to accommodate a patch of them and, were it only for the charm they add to the wayside, I would encourage their preservation along the borders of fields. However, the tent caterpillars, even at their peaks of abundance, do not seriously injure the wild cherries. Three weeks after complete defoliation these trees or bushes are in full leaf again and complete defoliation occurs only in years of caterpillar abundance.

But, should we not do something to prevent even this temporary defoliation? Perhaps we might if we knew more about it and thought that the gain justified the cost. However, we do not yet know enough to be prepared to take over Nature's care of out-of-doors; and some of the things that we have done in the case of the tent caterpillar do not now seem to be wise. This brief article can do no more than hint at the complexity of the situation and the meagerness of our knowledge concerning even this common insect.

Probably most of you have seen the rather motherly-looking brown adults of *Malacosoma americana* but possibly many of you have not recognized them as grown-up tent caterpillars. They appear in early summer, and each female, if in good health, places a band of eggs, laid one against another, around a twig. These eggs are smeared with a frothy material that dries into a shiny, dark brown protective cover, as is shown by the accompanying photographs.

Development of caterpillars starts at once and, if no disease or insect parasite is present, each egg will within a few weeks contain a perfectly formed caterpillar doubled up so that its head and tail are together at the outer end of the egg. Here progress usually stops until the following spring. Occasionally a few of the young caterpillars break through the eggshell and protective covering in August, and more rarely still, whole families hatch; but this precociousness does not seem to be an advantage to them.

Birth to death

When wild cherries begin to break into leaf in early spring, the tent caterpillars that have spent the winter, each in the cramped confines of its own eggshell, come out as though at a signal. Brothers and sisters huddle together on the deserted egg-mass for a while, straightening out their bent bodies, and then they move to their first meal of tender, new leaves. As they go they spin a thread of silk. In fact, a large part of the lives of these caterpillars consists of eating leaves and spinning silk. When clustered together after eating, they move from side to side, spinning the silk that forms the "nest"; when going from nest to food and back again, they spin threads of silk on the bark until the family has delicate carpets on which to walk.

Family life is abandoned when the caterpillars have become fully grown and each strikes out for itself to find some sheltered place in which to spin its cocoon. In the privacy of this cocoon it changes to its pupal form, looking somewhat like a small, fat, brown torpedo. Then quickly follows the marvelous transformation that results in the winged adult.

That, briefly, is the story of a lucky tent caterpillar's life, but by no means all tent caterpillars are lucky. In all of their stages they are in danger of attack by the natural agents that control their abundance. It would be well for Man to learn more about these natural controls and to avoid interfering with them.

There are thousands of kinds of insects that live by eating other kinds of insects. Some catch their prey, kill, and devour it at once. Good examples of these "predacious insects" are the caterpillar hunters, moderately large beetles of the genus *Calosoma*. Others, not very aptly called "parasitic insects," go about their predatory missions in a more leisurely and often complicated manner. Typically, the mother of a "parasitic insect" lays her eggs in her victims. The larvæ that hatch from these eggs live in the victims until they, the parasitic larvæ, are fully grown. Then they may pupate there or they may crawl out to pupate. In either case the victim, rather ironically called the "host," dies.

Helpful parasites

Many of these parasitic insects are wasplike creatures and some are so small that their entire larval and pupal life is passed within a single egg of their host. For example, in the latter part of July Mrs. T. S. Homans kindly sent us tent caterpillar egg-masses from Long Island. Although these eggs had been laid only about a month before they were received, and the caterpillars would, for the most part, not hatch until the following spring, tiny adult wasps were already emerging from them. Twenty-five or 50 were crawling about in the packing box when it was received, and 183 more emerged from 100 of the caterpillar egg-masses during the next month. In nature these wasps would probably have laid their eggs in the eggs of some other moth, the resulting young wasps would have passed the winter in the despoiled eggs of that moth, and adults would have been ready next summer to attack the eggs of a new brood of tent caterpillars. Suppose there had been an organized campaign last summer to collect and burn tent caterpillar egg-masses. The burning would have destroyed thousands of these wasps that Nature uses in her control of not only the tent caterpillar but also of the other caterpillars. We do not, as yet, know what those other caterpillars are, but we may be reasonably certain that, from the human viewpoint, they are undesirable. One of the troubles with Man's interference with natural processes is that its bad effects do not stop with the matter immediately in hand but involve a whole complex of delicate balances.

To be sure, most of the organized campaigns for collecting egg-masses wait until winter,

when the egg-masses can be more readily seen. By that time the wasps just mentioned would be out of the egg-masses and escape burning. But that is not the whole story. There are other kinds of parasitic wasps that pass the winter in the egg-masses and emerge very early the next spring along with the tent caterpillars that have not been eaten.

Nature's forces rally

For example, Miss Olsen, secretary of our department, kept a careful record of 100 egg-masses from each of four localities near New York City. About 62,000 tent caterpillars and about 2000 tiny wasps came from these 400 egg-masses in the spring. It is true that destroying egg-masses in those localities the preceding winter would have killed about thirty caterpillars for each destroyed wasp, but we must remember that this was near the peak of caterpillar abundance and that Nature was just building up her forces to control the species. Furthermore, we do not know what good work these tiny wasps do between the time that they emerge from tent caterpillar eggs in early spring and the time that their children parasitize the next laying of tent caterpillars in mid-summer. On the other hand, it is also true that a careful study has not yet been made of these parasitic wasps that spend the winter in the tent caterpillar egg-masses. There is a possibility that at least some of them were "secondary parasites" living at the expense of the wasp larvæ that had earlier eaten eggs of tent caterpillars. Clearly, "secondary parasites" that kill the "primary parasites" that kill the tent caterpillar are friends of the caterpillar and it might be to Man's advantage to get rid of them. Quite as clearly, however, the situation is so complex that, without more knowledge of the facts about insect life in general and about the natural history of the tent caterpillar in particular, we are not ready for drastic interference with Nature's balance.

But what about the tent caterpillars that do succeed in hatching? In years of caterpillar abundance caterpillars are certainly abundant. Miss Olsen's figures showed an average of 155 caterpillars per egg-mass last year, even including the parasitized masses. As an example of occasional abundance, Mr. A. Klein brought me a prize twig having eight such egg-masses on less than a foot of twig. Before considering

Nature's further checks, let us look at the simple matter of starvation.

Natural control

Suppose the wild cherry bushes or trees in a given area could support an average of 500 tent caterpillars each. In a peak year there might be an average of ten or more egg-masses to each wild cherry. Taking 150 as a rough average of the number of tent caterpillars hatching from each egg-mass, there would be 1500 or more caterpillars to be fed by trees that could feed only 500. In such a case the only caterpillars that would not starve before they were able to mature and leave progeny for the next year would be the few that were lucky enough to be on isolated bushes upon which only two or three egg-masses had been placed by the previous year's moths.

Now suppose that well-meaning people had encouraged children to gather egg-masses in the previous winter and that the children had been so thorough that they got eight or nine out of every ten egg-masses. That would leave an average of one or two egg-masses or about 200 caterpillars on each 500-caterpillar wild cherry and, so far as food supply is concerned, all could come to full-fed maturity in an area where few would have done so if the well-meaning people had let Nature alone. Furthermore, those 200 caterpillars per average bush would not suffer from other effects of overcrowding such as contagious diseases.

The working of disease when the caterpillar population is dense was very vividly illustrated in a waste field near my home last summer. Before the caterpillars were half-grown, dead individuals were seen here and there, and a week later there was scarcely a nest in the whole field that was not festooned with the limp skins of dead and dying. There will be very few tent caterpillars in that field next spring.

This epidemic of caterpillar diseases was not so striking in my own yard but it was there. I had purposely allowed several families of tent caterpillars to remain on each of my two apple trees and did not spray the trees. (If the owner of apple trees wishes a crop of good apples he should spray to kill the larvæ of the codling moth—a foreign insect—plum curculio, and other pests. These sprays also kill tent caterpillars. Therefore, when a tree-owner complains that tent caterpillars are eating his apple leaves, we need not feel very sorry for him, because it is evident that he was not taking

good care of his trees at any rate.) Long before the usual time for the tent caterpillars to leave the trees in their search for a protected place in which to spin cocoons and pupate, many of the caterpillars became restless and crawled to or near to the ground. Most of these were sick, some of them apparently having the same disease that caused the wholesale deaths in the waste field, others apparently having something else wrong with them. From time to time I caged samples of tent caterpillars that were leaving my trees. Of 880 such caterpillars only 117 lived to spin cocoons; and of these only about 50 emerged as moths; and most of these adults were so deformed and sick when they emerged that they were in no condition to perpetuate the species. Natural control was certainly acting in my yard.

Nature's time-tested technique

As was discovered some years ago by Mr. Brown at our field station for the study of insects, another important disease affects the ovaries of the adult moth, preventing her from laying eggs. The importance of parasitic insects in controlling the abundance of plant-feeding ones can scarcely be overestimated. How important in comparison with diseases they may be in controlling the tent caterpillar we do not know. It is quite possible—indeed, it seems almost probable—that, in the case of a gregarious species such as the tent caterpillar, diseases may be the more important. Possibly if we knew more about these and other diseases affecting insects, we could keep cultures of the various diseases on hand and spread them in places and at times that would be to our advantage; but at present, not having the knowledge, it would seem wise to avoid doing anything that might interfere with Nature's time-tested technique.

I have already referred to the insects that parasitize the eggs; but caterpillars that succeed in hatching are by no means free from their insect enemies. The majority of parasitic "wasps" and flies wait until their "hosts" have hatched. The list which the U. S. Bureau of Entomology and Plant Quarantine kindly sent me records 6 kinds of wasps reared from the eggs and 37 kinds of wasps and flies reared from the larva and pupæ of the tent caterpillar. From the relatively few cocoons of the tent caterpillar that we collected last summer we reared scores of these parasites. They emerged in mid-summer and, since the next chance they

could have at tent caterpillars would be about ten months later, they undoubtedly attack some other kind of caterpillar in the meantime.

Nature's cycle

Well, I have given you a very sketchy account of some of the troubles that beset tent caterpillars. In my own neighborhood they were so abundant last year that the death rate from starvation, disease, and insect enemies was extremely high. As a result, I expect far fewer tent caterpillars there next season. And, since both diseases and insect enemies increased last year and will probably be carried over the winter, I expect that such tent caterpillars as there are next season will have a very hard time. Consequently, there probably will be still fewer two years from now. Eventually the diseases and insect enemies will largely die out, because families of tent caterpillars will be relatively few and far between. Then the number of tent caterpillars will increase again to a peak, completing the cycle. Meanwhile, the wild cherries will not have suffered serious injury and, with a little care on our part, neither will our orchard trees and ornamentals.

Unknown factors

It is for such reasons as these that we now discourage so far as we can Man's wholesale

interference with Nature's control of the tent caterpillar. Let Man take care of his cultivated trees but let Nature take care of the wild cherries.

If I have given you the impression that we know very little about the life of this common insect and its complex relations with other living things, I shall not be disappointed. A realization of ignorance is the beginning of wisdom! As a matter of fact, we know even less about the lives of thousands of other kinds of insects in our neighborhood than we do about the tent caterpillar. The study of insects is still in its infancy. We are still largely in the preliminary but fundamentally important stage of describing and naming the species. One of the greatest needs in biology today is intensive work on the biology of insects. For this work we need field laboratories equipped with capable research men. The search for the "unknown factors" in the biological equations involving human affairs is a matter for pure science, but it is extremely practical as a necessary foundation for applied science—in this case for finding solutions to the problems involving our relations with insects. Until these factors are known, we can have no satisfactory solutions of the problems, and, unless they are found, it may well be that the "insect menace" will become a real one.

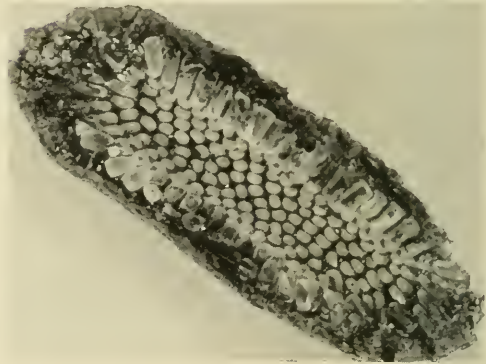


*A parasitic wasp—
an enemy of caterpillars, a friend of
Man*

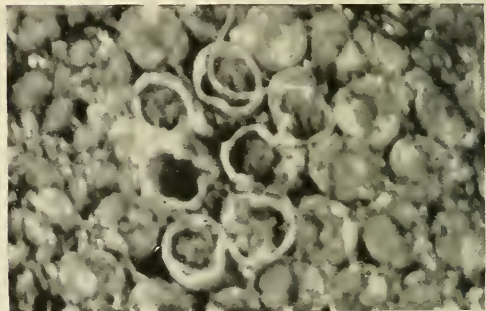


(Above) Each egg-mass is laid in a band around the twig and smeared with a protective sheath (Half of band removed)

(Below) Here the twig has been removed. (About four times actual size)



(Below) Eggs enlarged about fifteen times. Tops of seven are removed, showing caterpillars in six



In a peak year. On less than a foot of twig shown above there are eight egg-masses. Under such crowding none of the caterpillars will mature

Tent Caterpillar?



(Above) A group of newly hatched caterpillars on egg-mass

(Below) A fully grown caterpillar



(Above) A silken cocoon spun by a fully grown caterpillar about to pupate



(Above) The same cocoon opened. The larva has molted and become a pupa. The old larval skin may be seen at the lower end of the cocoon



(Above) The adult stage of the tent caterpillar, a brown moth, shown here about four times natural size



Beetles known as caterpillar hunters (Calosoma) are among the caterpillar's natural enemies

(Below) A healthy family of tent caterpillars. A large part of their lives is spent in eating wild cherry leaves and spinning silk



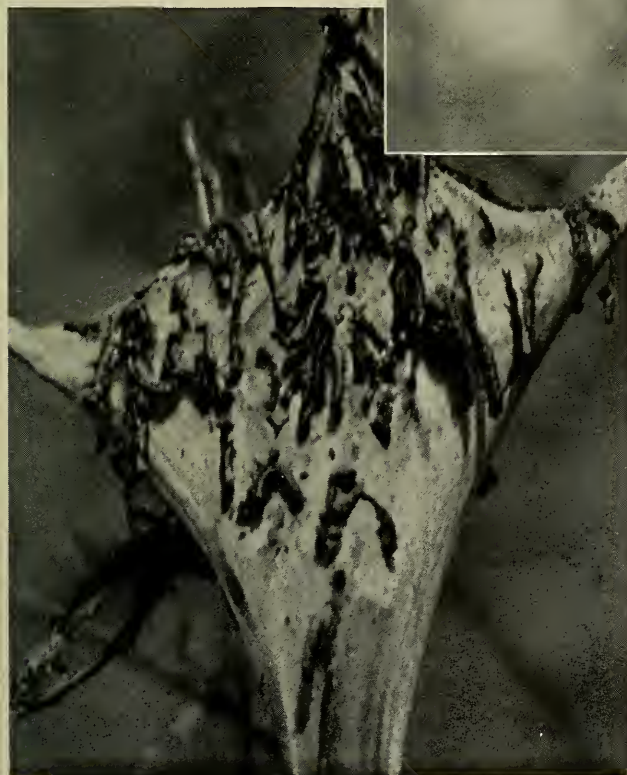
(Above) Tent caterpillars following their silken paths spun between food and rest

Healthy

Diseased

Disease has started in the tent caterpillar family shown at the right. The caterpillars have reached their periodic peak and Nature is restoring her "balance"

(Below) The family has been exterminated by disease



(Below) A tent caterpillar dying of bacterial disease



Before



After



(Top) A wild cherry defoliated by an over population (three nests) of tent caterpillars

(Bottom) Three weeks later. The caterpillars have starved but the wild cherry

has not been injured. "Kill, if you wish, the tent caterpillars on your orchard trees and ornamentals, but let Nature take care of the wild trees, and under no circumstance cut down wild cherries"

Rhineodon at New York's Front Door

*The whale shark's farthest north by 335 miles. His capture off
Fire Island Light, August 9, 1935*

By E. W. GUDGER

Associate Curator of Fishes, American Museum

JUST as I was locking my desk preparatory to leaving my office on Friday, August 9th last, the telephone rang and an excited voice asked if this was the department of fishes in the American Museum. On being answered affirmatively, the voice said:

"We've just brought in to Islip a mighty big shark. Do you want it?"

Not dreaming what marvelous fortune was in store for me, I answered "Not at 5 P. M. after eight hours work on a hot August day."

Indignantly the voice said "This is no ordinary Long Island shark, it's a whale of a fish."

I then asked for its size and the answer came back "thirty-five feet." Whereupon I sat up and took notice.

Just another basking shark?

I knew that in our waters only two sharks reach this great size—the whale shark, *Rhineodon typus*; and the basking shark, *Cetorhinus maximus*. The whale shark, a tropical fish, had never been known to come in any ocean so far north by 335 miles. On the other hand, the basking shark is a cold-water form which on our coast ranges as far south as the North Carolina capes. Hence I thought this Islip fish must be a *Cetorhinus*. Furthermore, since we had obtained and had mounted a thirteen-foot specimen of the basking shark taken on the New Jersey coast a few years ago, I was not particularly interested.

However, to make sure I asked what kind of nose the shark had and was told that it was square cut. A question about the mouth brought the answer that it was at the front end of the square-cut head. My next query was about teeth, and the answer came that they were so small that they could hardly be seen.

Surely not a whale shark!

Was it possible that my informant had a whale shark before him? I queried:

"Did you ever see a Long Island shark that did not have the snout pointed, the mouth underneath the head and filled with large sharp teeth?"

Quick as a flash came the indignant answer: "Man, I'm telling you just what I see as I look out of my window at the head of this giant."

I was now almost convinced but, to establish the identification positively, I asked and was told that there was a median ridge on the center of the back, that there were three ridges on each side and that the lowest ran out on to the tail. Inquiry as to color brought the statement that it was dark with vertical yellow bars and that in the checkerboard squares made by these with the ridges were large yellowish-white spots. This made me absolutely sure of the identity of this great fish.

As wildly excited as the man at the other end of the wire, I shouted "Man alive! you've got a *whale shark*, the only one that ever came so far north not only in the Atlantic Ocean but in any ocean."

As it was now closing time, my colleagues, John T. Nichols (of the department of fishes)

and Harry C. Raven (of the department of comparative anatomy) had foregathered in the next office preparatory to leaving for their homes on Long Island. With ears assaulted by the "thunder of the captains and [especially] the shouting," they had come in to see what it was all about, and to suggest that if I would open my window, the man in Islip could probably hear me without the intervention of the telephone. But on hearing the words "whale shark" they too (knowing how rare this fish is) became almost as excited as I was.

The speaker at Islip then asked "Can't you come out and see and identify our fish? We want to exhibit it."

I answered that I did not know where Islip was nor how to get there. Then Nichols said, "Gudger, you must go. You will never again have such a wonderful opportunity to see a whale shark in the flesh. You must not miss this chance." And Raven spoke up—"Come out with me on the train to Baldwin and I will get my car and drive you out to Islip." Whereupon I shouted to the man at the other end of the wire "I'll be out about 7:30 and I'm on my way now. Good-bye!"

After twenty-three years' pursuit

In July, 1912, at Miami, Florida, I had seen hanging over a long pole under a shed, the skin of the thirty-eight-foot specimen of the whale shark, *Rhineodon typus*, taken some weeks earlier at Knight's Key. I had and I have never seen a whale in the flesh, but this skin, big enough to cover a medium-sized whale, was the most enormous that I had ever beheld. Three years later I saw this skin after it had been (poorly) mounted, and then I began to realize the enormous bulk that this largest of sharks attains. But I had to see the fish in the flesh to get an adequate idea of its colossal size, of its mastodonic proportions.

In the twenty-three years since that sight of the skin at Miami, I have hunted *Rhineodon* not in the "seven seas" but in the warm and warm-temperate waters of the three great central oceans—in books and scientific journals and in a world-wide correspondence. As a result of this long drawn out search and correspondence, I was able as of January 1, 1935, to list 76 recorded specimens plus an indefinite number which had been seen but not recorded by scientific men. Of the 76, as a result of the far-flung correspondence and by virtue of my

(self-constituted) position as official recorder of the occurrence of the whale shark, I had myself put 32 specimens on record. And in all these twenty-three long years, I had never seen *Rhineodon*.

Four disappointments

Four times I have missed seeing whale sharks in Florida waters and have lost the opportunity to get a skin for the Museum. (1) In May 1912, on my way to the Marine Biological Laboratory of the Carnegie Institution of Washington at Tortugas, last far-flung outlier of the Florida Keys, by being two days too early, I missed the capture at Knight's Key of a 38-foot "sea monster." No one knew then what this great animal was. But as noted above, I saw the skin late in July and identified it as that of the whale shark.

(2) On June 11, 1919, a telegram to the American Museum announced the capture on the previous day of a 31-foot whale shark in the Bay of Florida near Cape Sable. But I was chained to Volume III of the *Bibliography of Fishes* (of which I was editor) and could not go.

(3) On June 9, 1923, a 31.5-foot *Rhineodon* was captured at Marathon, near Long Key, Florida, and next day word of it came to the Museum. Again I could not go. I was just out of hospital and it would have been suicidal to have made the journey and undergone the fatigue necessary to get the skin. However, Mr. L. L. Mowbray, now of the Bermuda Aquarium, was at Miami and went at once to Marathon. Of his heroic but futile efforts to tow the fish to Key West where it could have been skinned, the story has been told in *NATURAL HISTORY* for March-April, 1930.

(4) On January 18, 1932, an 18-foot specimen was taken in the Gulf Stream off Miami. On the 19th, a telegram came to the Museum which simply read "Huge shark captured here. Do you want it?" This was referred to me, but as all other Florida whale sharks had been taken in summer, I judged that this winter-captured fish was a huge hammerhead (a gigantic specimen of which I had had word at Miami) or else a huge tiger shark whose kind abounds in those parts. A wire of inquiry as to what the fish was was sent but, when the answer came twenty-four hours later, the fish had been disposed of and the skin removed.

What a saga of ill fortune and hard luck!
But the tide turned that evening of last August.

The whale shark in the flesh

Raven and I reached Islip about 7:30 P. M. and were directed to the plant of the Sunrise Fish Company. The shipping room had double doors back and front and was about thirty-five feet deep. When I stepped up on the loading platform in front, the mammoth fish lying on the concrete floor seemed to fill the whole room from door to door. The gigantic head and gill parts, looking somewhat like a huge collapsed crate with one end gone, seemed to fill the whole doorway. From this, the huge body, as large as a great oak in a primeval forest, stretched back and back to a vast tail within the spread of which a tall man could stand with room to spare. The whole thing was unbelievably enormous.

For the first time in my life I beheld a whale shark in the flesh, the hugest thing that I ever saw come out of the sea. I looked at it head on, I walked around it, I climbed on its broad head, and I walked down its great back. It was the most enormous, the most colossal, the most gigantic sea animal I had or have ever seen. I am drained dry of adjectives. What is needed is the vocabulary of the advance press agent of a circus.

I have no standards of comparison for this fish. I have caught and dissected 10- and 12-foot hammerhead and tiger sharks at Beaufort, N. C., and at Key West and Tortugas, Florida. These probably weighed 600 to 800 pounds and to get them up on the dock with a derrick and tackle had required the help of all the loafers on the dock. But here was a fish three times as long as any of these and seemingly ten times as big, whose weight must be estimated in tons and which would require a power-operated derrick to lift. I was simply overwhelmed.

When I recovered somewhat from the mental paralysis induced by the shock of seeing this "monster," Raven and I measured it. The details of sizes and structures will be left for a technical paper. But a few of the measurements may be given here sufficient to make clear that the adjectives applied are justified.

The fish measured 31.5 feet in total length. The width of the head over the curve between the eyes was 5 feet. The same measurement over the curve at the first gill-slit was 6 feet

5 inches. The width of the mouth straight across from corner to corner was 44 inches—just 4 inches short of 4 feet.

The teeth forming a broad band in each jaw, were only about one-eighth of an inch high. It was impossible to get girth measurements since the huge fish had flattened immovably on the concrete floor. However, we measured the fins. The breast fin measured 5 feet long in a straight line. The corresponding pelvic fin was 3 feet 9 inches long. The huge dorsal fin was 4 feet long on its base and 2 feet 4 inches high, and the measurement along the curve of its edge from base to tip was 45 inches.

The tail fin was almost as big as the propeller of a steamer: 7 feet 3 inches + along the curve of the upper lobe and 4 feet along that of the lower lobe. The + sign for the measurement of the upper lobe is inserted because some visitor had cut off the tip of the tail and had carried it away as a souvenir. The spread of this gigantic tail fin was 9 feet.

The extraordinary capture

Friday, August 9, 1935, was literally "Fish Day" for the Schaper Brothers who operate the Sunrise Fish Co. of Islip, L. I., for on this day was captured the whale shark, "the most valuable fish we ever caught." Its manner of capture was unique. With one exception all other specimens that have come into the hands of man, have either been left dead on shore by tides and waves, or have been caught with harpoons and have been killed with bullets. This *Rhineodon* (a male) captured himself in a pound net or trap off Fire Island Light on the south shore of Long Island. One other whale shark is reported to have been found in a fish trap—in the Gulf of Siam many years ago.

The Schapers operate a pound net fishery of four pounds or traps off Fire Island and when with their crew they went out early on the morning of August 9 to fish these traps, they had no premonition that this was to be a day of high adventure for them. The weather was moderate, the sea quiet with only a slight swell, and there was hardly any breeze.

They first hauled their three nets to the westward (the Long Island shore trends nearly east and west) and then last of all went to the east to fish No. 1—and as the sequel shows this was fortunate. Thus all unsuspecting what unusual contents it might hold, they ran up to trap No. 1. But for the fact that Fire Island

is not wooded, the photograph on page 169 of an ordinary pound net will show what the Schapers saw on this memorable morning.

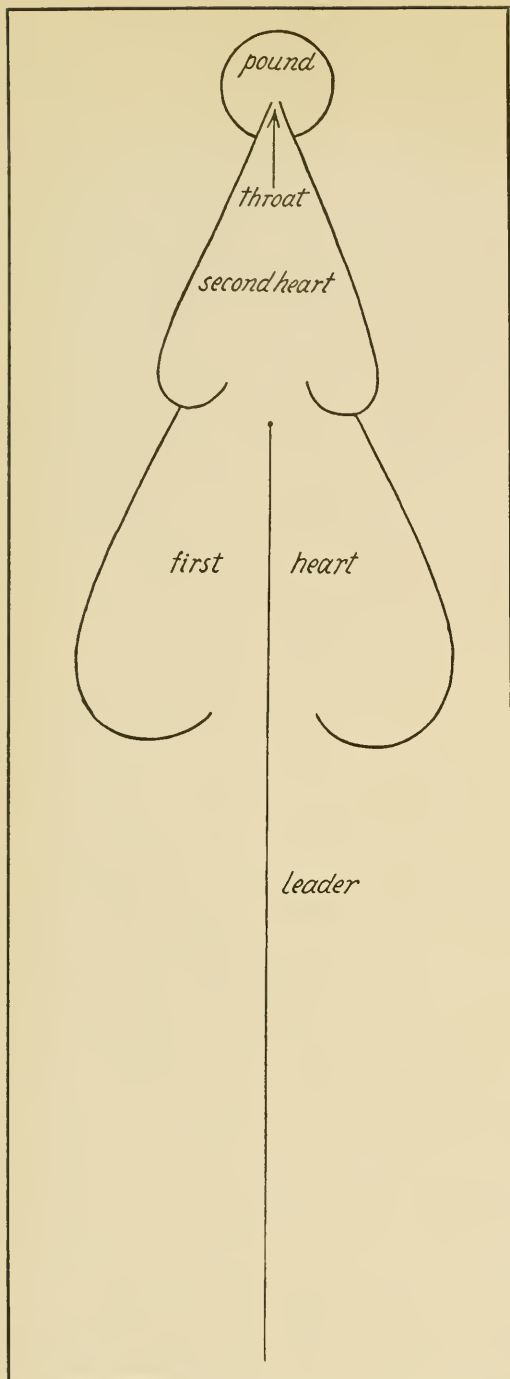
The net that caught the fish

However, the Schapers' pound net is not of the ordinary kind, but is one which is the outgrowth of their experience. Hence it is well here to refer to the drawing on this page and to give a description of their pound net or trap with a brief explanation of how it works.

This huge trap is supported on poles as long as a ship's mast. First there is the 1800-foot "leader" which begins inshore in water 40 feet deep and ends out in water 56 feet deep and everywhere reaches from bottom to surface. This leads into the first "heart," which measures 230 feet around each curve. The first "heart" leads into the smaller second one (195 feet around each curve), and it into the "pound" or pocket. The first heart has at the base on each side of the "lead" openings 60 feet wide and about 50 feet deep, while the "doorway" at the tip is 40 feet wide and 52 feet deep. The second heart opens into the "pound" by a channel which at the base or rear is 15 feet wide by 56 deep, but which narrows to 4 feet wide and 49 feet deep at the front end in the pound. The pocket is a bag 60 feet in diameter and 56 feet deep, suspended on long poles set several feet outside the pocket, so that the net will swing clear of the poles and about two feet above sea bottom. At the tops of the poles are pulleys through which are rove ropes attached to the bottom of the pocket. By these the bottom is brought near the surface so that the captured fish can be easily removed.

Here is how this trap and its parts work. Fishes going east or west along the shore strike the leader and working toward deeper water find their way into the first heart. Their tendency is to still go forward into the second heart and from it into the pocket. The fish seem little inclined to come out through the doorways, but are always nosing against the net. So the whale shark got in and so he behaved.

When, early on August 9, the fishermen reached their net, everything appeared normal, the great fish being invisible. The crew presently began to lift the pocket, working on the "throat" first to close that way of escape for the fishes. When the throat had been hoisted half-way up, the great tail of the huge fish came into view. Arie Schaper from his low (18-foot)



HOW A POUND NET WORKS

This diagram illustrates just how the 1800-foot leader guides the fish until they reach the pocket at the other end. This particular pound trap was perfected by the Schaper brothers, who operate a pound net fishery off Fire Island.

power boat cried out "What is that in the net? It must be a whale." And Richard from the higher pound boat (a 45-foot Seabright dory with a heavy-duty engine) answered "Something enormous! It must be as long as the pound boat." Arie then went aboard the pound boat, got a better look, and said "Let's get this thing ashore, exhibit it and make some money."

Leviathan in the net

Fortunately Nicholas Schaper had brought out this day a power-operated lighter to replace some poles in the leader which had been loosened by heavy tides. This had on it a derrick and block and tackle operated by a gasoline engine. And now Nick was invited to bring his lighter and derrick and "get this whale." The lighter came up and all hands took part in sizing up the situation. When the magnitude of the task was realized, to make sure of the fishes already caught, the pound boat with the merchantable catch was sent off to Islip while the lighter and seven men stayed behind to catch the "whale."

Then came the question as to who would "bell the cat," as to how this great monster was to be captured. Well might the fishermen have asked the questions propounded in the Book of Job and weighed the statements therein.

Canst thou draw out leviathan with a hook? or . . . with a cord which thou lettest down? Canst thou put a hook in his nose? Wilt thou play with him? . . . or wilt thou bind him? Canst thou fill his skin with barbed iron? or his head with fish spears? He esteemeth iron as straw and brass as rotten wood. The arrow cannot make him flee. Darts are counted as stubble.

However, the hardy fishermen were determined to finish the capture of their prey and get him ashore. And since there was no harpoon on board wherewith to secure the shark, Nick called for volunteers to take one of the 18-foot power skiffs and go into the pocket and get a line around the tail of the animal. Everybody volunteered, and Nick and three other men in their boat entered the net and tackled the whale shark.

The effort to get a line around his tail was futile. The great tail swung back and forth in 15-foot arcs and kept men and boat dodging. Once the fish came up under the boat and lifted it a foot out of water, but it slipped off his broad back. Next *Rhineodon* took up the old shark trick of rolling and twisting. All this

time the other men were hard at work raising the pocket, making it shallower and restricting the space in which the shark could maneuver. The weight of the net plus the weight of the huge shark made the tips of the long poles lean inward. This brought the edges of the net (ordinarily about one foot above water) under the water and the shark seemed about to slip over the edge of the net and get away. A bow-line noose made of a stout manila rope was lowered in front of the shark as he was endeavoring to get over the edge of the net. When he did come over, the noose was so manipulated that the line slipped over his head, and when line and knot had slipped behind the fish's breast fins, the slack was taken in and the shortened line made fast to a pole. The tired fish being now fairly quiet, another line (technically a "strap") was rove around his tail, and both lines were taken to the lighter and made fast.

A heavy wire from the winch was now rove through the block at the end of the derrick boom and hooked into the "strap." The power was put on and the tail of the whale shark hoisted ten feet above the water. Then the lighter began her journey home, towing the shark tail foremost. But as the water caught the great breast fins, the fish would roll in such fashion that it was feared that the wire would twist in two, so a heavy chain was substituted. Once inside the Fire Island Inlet, it was decided that faster progress must be made if they were ever to get home. So a looped wire was put around the fish and it was lifted on board the lighter and secured. And so into Islip, seven miles away. The fish was first seen at 9:30 A. M., the start made about 12:30, and Islip was reached at 4 P. M.

On shore at last

The lighter was tied alongside the dock and the fish unloaded by means of the derrick and winch. Boards were then laid into the back door of the fish house. A Mack truck was backed up to the front door and harnessed to the whale shark. Slowly with much puffing and backfiring the truck dragged *Rhineodon* up on to the concrete floor where I found him as described above.

This whale shark, like all others for whose capture there is any data, at no time put up any fight. At no time did it attempt to bore through the net as a basking shark had recently

done when caught in the same trap. It contented itself with rolling and twisting. Had it exerted its great strength, it surely would have torn its way out or maybe would have carried part of the net with it. This is undoubtedly the most unique capture on record of a whale shark, for the Siamese fish referred to above was not captured but died in the trap.

The most northerly record

The whale shark is a tropical fish which rarely departs from its normal habitat and then ordinarily only for a comparatively short distance in a friendly warm ocean current. It is such a rare fish that its capture is in the way of being an event at any time. And when one is taken 1180 statute miles from the tropics and almost at Father Knickerbocker's front doorstep, and when this great fish catches itself in a trap, it is an occurrence so unusual as to call for its recording.

Until this specimen was caught its "farthest north" was in the Pacific Ocean at Cape Inubo, just east of Tokyo, on the great Japanese island Hondo, in latitude $35^{\circ} 39'$ North. Its most southerly station is off the southern end of Africa in Table Bay near the Cape of Good Hope—latitude $33^{\circ} 55'$ South. Thus its northern limit is about 2452 statute miles from the equator, its southern range about 2333 miles from base line. These extremes are far outside the tropics in both cases: 837 miles at Cape Inubo, and 717 miles at Table Bay.

The explanation is essentially the same in both cases. The whale shark is relatively abundant in the Philippines and has been carried from these waters to Cape Inubo by the Kuro Siwo or Japan Current. *Rhineodon* has been known for 65 years to be not uncommon in the western Indian Ocean, around the Seychelles Islands. Thence it is carried south to the Cape by the warm Agulhas Current and its components. So the first specimen (15 feet long) ever recorded was carried to the Cape in 1828 the year of its first discovery. And so was brought the last specimen (20 feet "over all") taken in those waters—in 1934.

In the Atlantic Ocean, eight specimens (the last in the year 1936) have been recorded from what may properly be called the Straits of Florida region. The most northerly of these was an 18-foot specimen which came ashore in 1902 at Ormond Beach in about 29° North Latitude. This record stood for 32

years until one was stranded in June, 1934, on the southern side of the mouth of the Cape Fear River, in about the latitude of Cape Fear, N. C. (34° N.) some 325 miles north of Ormond Beach. This new northern record for the Atlantic is surely to be credited to the help of the Gulf Stream.

And now comes the capture by the Schaper Brothers of a 31.5-foot whale shark off Fire Island Light-house, Long Island, in latitude $40^{\circ} 38'$ North—the most northerly record not only for the Atlantic Ocean but for the world. This isolated individual, undoubtedly carried hither by the Gulf Stream, had strayed far from its tropical habitat—2786 miles from the equator and 1180 from the Tropic of Cancer, and about 450 miles farther north than the specimen recorded from the mouth of the Cape Fear River. Furthermore the Fire Island fish breaks by 335 miles the northernmost record previously held by the Cape Inubo rhineodons, and by these 335 miles it sets a new record for the greatest distance from equator and tropic.

This specimen, moreover, has another distinction—it is the eightieth *Rhineodon* on record as will now be shown. It may interest the reader to know that as of January 1, 1935, I had listed 76¹ whale sharks definitely recorded from the three central oceans. Since then I have recorded a new capture (the sixth) at Acapulco, Mexico, and another (the third) from Havana, Cuba. Then Brimley has listed the specimen (referred to above) from near Cape Fear, N. C. These make 79 records of the occurrence of *Rhineodon typus*. That from Fire Island Light is No. 80 for the whole world.

The fate of this whale shark

The captors and owners of the whale shark, Messrs. Arie, Nicholas and Richard Schaper, showed the finest possible spirit of coöperation with Raven and myself as representatives of the American Museum and told us on Friday that ultimately we might have any parts of the fish that we desired. However, they wished to exhibit the fish on the Saturday and Sunday following and thus recoup themselves for the expense to which they had been subject in capturing the great shark and bringing it in to the fish house. They then said that by Monday

¹ Proceedings Zoological Society of London (for 1934), 1935, p. 882.

afternoon or Tuesday morning the fish might be expected to be in such condition that it could no longer be exhibited and that we could then have what parts we wished.

Now it had happened some four months before this that a member of the American Museum, Mr. Charles T. Wilson of New York, had presented to the Museum the skin of an 18-foot whale shark taken at Acapulco, Mexico, and that this skin was in process of preparation for mounting. Here then was an embarrassment of riches. However, even if we could have had the skin of this giant, we had in our restricted exhibition space in the Museum no room for a 31.5-foot specimen. Hence we reluctantly asked for the head and gill-arches, for the eye, the heart and certain of the hard parts of the skeleton for the department of comparative anatomy in the Museum. These with great good will were promised to us, and in return Raven gave helpful advice about the use of ice and other preservatives to keep the mastodonic shark in condition for two days' exhibition. He and I then came away with promises to return on Monday.

A stream of visitors

On Friday, while Raven and I were examining the shark, making measurements and notes, a constant stream of visitors was passing through the fish house. The New York papers on Saturday morning (August 10) carried pictures of the great shark, and the enterprising fishermen sent out hundreds of handbills. As a result there was on Saturday and Sunday a great and constant stream of visitors to see the whale shark, and the small admission fee charged brought in a large aggregate return to the Schapers. Among the visitors was Mr. W. K. Vanderbilt, who was so much struck with the great fish that he negotiated for the skin on the shark, this to be removed at his expense.

On Monday, August 12, Raven went to Islip about 11 A. M. and found a smaller but constant stream of visitors still viewing the prize of the Schaper Brothers. He was told that Mr. Thomas Rowland, the well-known taxidermist of New York City, representing Mr. Vanderbilt, would that afternoon begin to remove the skin, and that about noon the next day we could get the parts we desired. These matters Raven communicated to me by

telephone, and I at once requisitioned for a Museum truck for early next morning.

August 13, a lucky day

On Tuesday, August 13 (a lucky day for us), Raven was early on the scene and early telephoned to me that *Rhineodon* had been dragged out on to the lighter and that the skinning had been begun the day before, that it was progressing satisfactorily, and that I should bring the truck out about noon. About that hour I reached the scene of activity and found that Mr. Rowland and his men had got the skin from the body up to the gill and head parts. The removal of the exceedingly thick skin offered many difficulties, and trebly so in the gill and head region and it was not until about 3 P. M. that the skin was free from the whole body and the Brobdingnagian task ended.

Since the rubber-like skin was about 4 inches thick, and was 25 feet long (to base of tail fin) and about 15 feet in full breadth, its stiffness and weight made its removal a problem. Indeed, the skinning was made possible only by dragging the fish out on the dock and lifting it on to the lighter above referred to with a block and tackle from the yard-arm of the mast, the power being supplied by a gasoline engine. A line was then looped around the tail portion of the skin and as fast as it was cut free from the flesh (one cannot husk the hide off a shark as one can from an ox), it was lifted up so that the skinners could advance farther headward.

Finally about 3 P. M. the skin was freed from the head, and Raven went into action. With an axe he cut off the head and by means of the derrick we loaded this on the Museum truck. He next got an eye, some of the gill-arches, the heart, and a section of the curious tubercle-lined oesophagus. The fish being a male we were unfortunately debarred any opportunity of deciding whether the whale shark voids its eggs out in the sea water or whether it brings forth its young alive as most of its kind do and as there is fair reason to believe *Rhineodon* does.

As for the other viscera, they were too mastodonic for anything to be done with them. For instance the left lobe of the liver was 9 feet long and as large around as a man's body. Let the reader look at a 6-foot man standing

against a wall, let him mark off 3 feet (half the man's height) on the wall above his head, and he will have the length of the liver—9 feet, the height of the average ceiling of the ordinary house. We might have brought in the 10- or 12-foot long spiral-valved large intestine but we had no container to put it in and our truck was loaded.

Back to the deep

With the skin removed, there remained the matter of disposing of the carcass. Frank Buck (of *Bring 'Em Back Alive* fame) wished to purchase it to feed to the carnivorous animals at his Long Island station, but was deterred on finding that some formaldehyde had been poured on the skin as a preservative. So the

Schapers had to carry the carcass out to sea, attach heavy weights and sink it.

What we all got

The fishermen got a large return from exhibiting "the most valuable fish we ever caught."

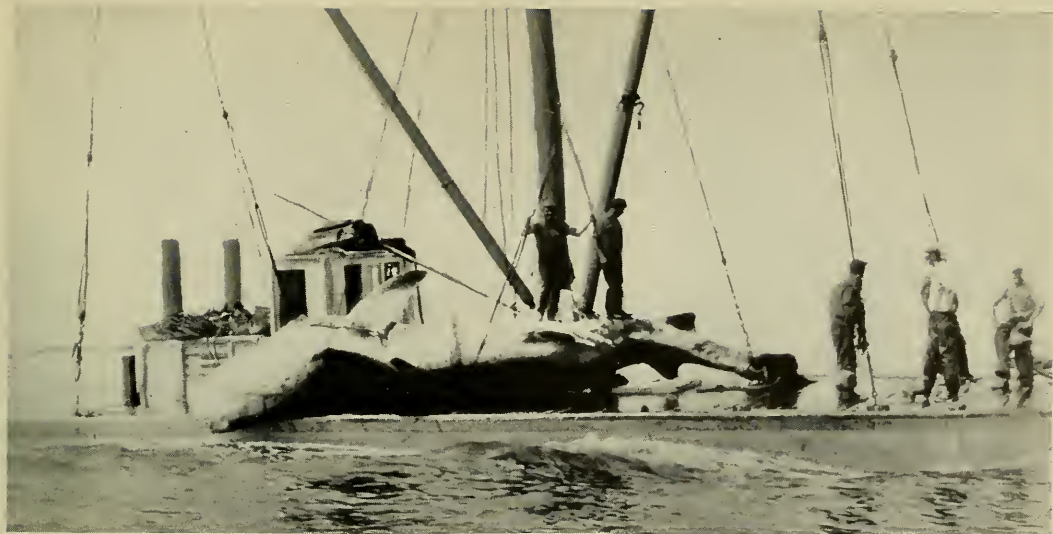
Mr. Vanderbilt got the skin of a full-grown whale shark for mounting and display in his museum at Northport, Long Island.

The American Museum got the skull and other precious material for future study.

The sharks and other fishes, and the crabs out in the ocean got a great feast that lasted for days.

And the writer (after twenty-three years' search) got a vivid memory of a whale shark seen in the flesh.





Rhineodon at New York's Front Door

(Above) Bringing in the prize. As soon as the lighter was inside Fire Island Inlet, the whale shark was lifted aboard by means of a wire looped around its body; the boat then made good speed to Islip

THE PHOTOGRAPHS
USED IN THIS SERIES
WERE PRESENTED
TO THE AUTHOR
BY THE SCHAPER
BROTHERS, WHO
CAPTURED THE
GREAT FISH



(Right) The gigantic tail fin had a spread of nine feet. Along the curve of the upper lobe it measured seven feet, three inches plus, and four feet along the lower lobe. The tip of the upper lobe had been snipped off by a souvenir hunter

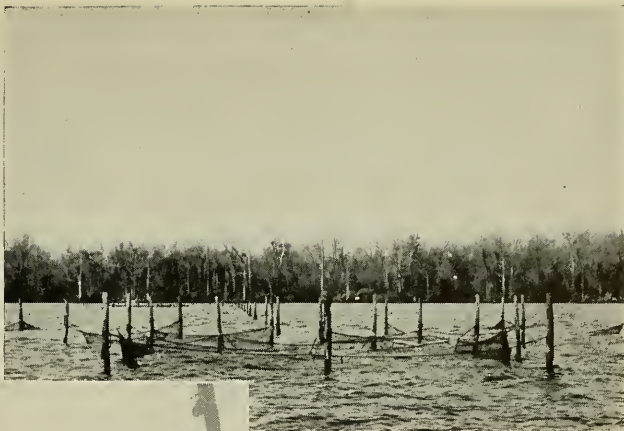


UP FROM THE SEA

Derrick and winch were used to unload the whale shark on to the dock. An admiring throng stood by and gaped as the huge

dimensions of the fish were fully revealed to their astonished gaze. Note the wide mouth and on the body the three ridges

At the right is a pound net as seen from above the surface of the water. This photograph is reproduced by courtesy of the U. S. Bureau of Fisheries



(Left) Here the carcass of the whale shark is being dragged on to the lighter preparatory to skinning.

In the picture below, the skinning is under way and is progressing satisfactorily despite the many difficulties presented by the exceeding thickness of the hide



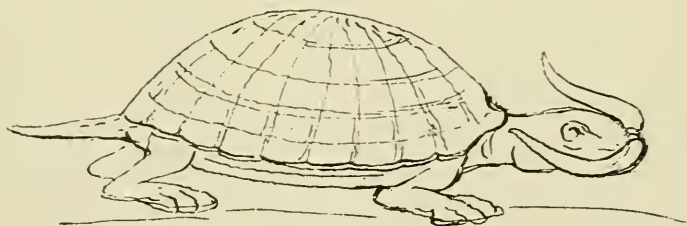


© by the American Museum. Painted by C. R. Knight under the direction of Henry Fairfield Osborn

THE MASTODON AS IT REALLY WAS

Mastodon americanus as it appears in the restoration painted by Charles R. Knight (above) is an amazing contrast to the Pedder interpretation shown below. (Below) James Pedder's restoration of the "Missourium," 1841. Impossible as it may seem, this restoration was based

on bones of a mastodon. The mustache-like "horns" are the tusks, and the legs have been folded down to make them look like those of a tortoise. The shell is wholly imaginary. This copy of Pedder's sketch was made by the English anatomist William Clift



Misconstructing a Mastodon

When misguided imagination was applied to some of the first mastodon bones ever found, an amusing freak of nature was created

By GEORGE GAYLORD SIMPSON

*Associate Curator of Vertebrate Palaeontology,
American Museum*

ALMOST everyone now knows what a mastodon looked like, thanks to the numerous skeletons mounted in museums and the many careful paintings and drawings made by artists under the direction of capable scientists. We know that it appeared very much like an elephant, differing only in some details of proportion, such as its relatively longer body and shorter legs. Now that this knowledge has been acquired, it is hard to conceive of the great difficulty that earlier workers had in interpreting the more scanty remains known to them and to realize that even intelligent and learned men at first did not see the resemblance to elephants. Even elephants were half-mythical beasts to many of them, and few Americans or Europeans had then seen one in the flesh.

Early "discoveries"

One of the earliest attempts to restore a mastodon is contained in some papers which Mr. C. D. Sherborn of London generously gave to me a few years ago for preservation in America. These papers are so amusing and so valuable for the sidelight that they cast on early discoveries of mastodons and on the history of science in America, that their most interesting passages are here published.

One of the first mastodon skeletons to be discovered, and the one referred to in these papers, was found by one Albert Koch in 1838 in Gasconade County, Missouri. Not recognizing its true nature, Koch dubbed his fossil

skeleton "the great Missouriium." He set up the bones after a fashion and exhibited them in America and later in London. During the London exhibition, the *London Times* for December 31, 1841, published the following notice of the beast:

THE MISSOURI LEVIATHAN

We are not disposed to place the most explicit confidence in anything that comes from our American friends. They deal too much in the marvelous, and, speculating on the good-natured credulity of the English, they often narrate to us strange stories, and exhibit for our amusement still stranger animals. A person by the name of Koch has recently imported from America the fossil remains of a gigantic animal between whose legs, it is said, the mammoth . . . may have strutted with ease . . .

The animal is supposed to be aquatic in its nature. This we should have inferred from the anatomical structure of its neck.

While the specimen was still in America, it had been seen by a worthy Philadelphian, Mr. James Pedder, the editor of *The Farmer's Cabinet and American Herd Book*. This gentleman had an original turn of mind, and he soon concluded that current ideas of the "Missouriium" were very erroneous, and felt it his duty to correct them. He therefore wrote to the man most qualified to judge the matter, Prof. (later Sir) Richard Owen, at that time the ablest anatomist in England. His letter, dated November 20, 1841, included the following passages:

May I trouble you on a subject, which, however, I presume you will feel interest in. By this time the Bones of the Missouriium are arrived amongst you:—they have made much noise in this part of the world, for there has been considerable "shaking amongst them, which is not yet entirely stilled . . . I have taken up the Idea that the Animal was of the Tor-

toise Tribe, and is therefore, improperly erected in its present shape And first, I would call your attention, particularly, to the bones of the Elbow-joint, and say, if the leg were to be carried out so as to form a junction whether the feet would not be spread out so as to bring the breast down to the ground? Then again the *front* of the bone of the arm at the Elbow-joint shews, by its smoothness caused by friction, that it must always have been carried in a bent or angular position, like the fore-leg of the Tortoise.

To publicize his opinion still more widely and to be sure of its receiving proper consideration from the British savants, Mr. Pedder also wrote on the same day to Petty Vaughan, Esq., of London, enclosing a detailed argument to be read by Mr. Vaughan to some scientific association. Not being very clear as to what association might have authority, Pedder seems to have left a blank in the last paragraph to be filled in by Vaughan as seemed best. The most interesting of Pedder's arguments were as follows:

THE MISSOURIUM

After minute investigation, and repeated opportunity for examination of the Skeleton of the Missouriium, I have been led to conclude that the animal was a Monster of the Tortoise Tribe 32 feet long and correspondent width, with the power of withdrawing its head within its shell; the tusks then forming a mail of defense around its edge to ward off obstruction

3rd. The order of the Neck-bones; the longer placed first, giving the power of withdrawing the head suddenly, and at a jerk, as it were.

4th. The Ribs, so small, short, and widely spread, with so little curve, and withall so weak, and placed edgewise to the body or *half reversed*, by no means calculated to give strength and support to a four-footed animal, 15 feet in height

6th. The short and flat tail: That of the Tortoise likewise

8th. The feet armed with Claws. Those of the Tortoise also:—too weak and small in their articulations for the support of the body; the weight of whose bones is near 3000 lbs—Their position also, being like those of the Tortoise, turned outwards; and in all probability, partially webbed

12th. The size of the Teeth, to appearance much too small for an animal as he appeared on exhibition

15th. With this view, the difficulty which has been felt with regard to the position of the Tusks, more properly *Horns*, is done away; they always having been carried near the Earth, and resting upon it, at the will of the animal

17th. In the Ancient Asiatic Mythology, the

Earth is supposed to rest on the back of an enormous Tortoise—from whence came the Idea, if not from a knowledge or hearsay of an Animal of the monstrous proportions here exhibited?

In accordance with these Views the inclosed Drawing has been made, and is submitted to the Examination and Consideration of the
with deference and respect by

Their obedient Servant
JAMES PEDDER

With this communication Mr. Pedder sent a sketch showing his idea of the tortoise-mastodon, which is here reproduced.

It now hardly needs to be pointed out that Pedder's argument and restoration are wrong in every detail, although all his mistakes were natural enough in that day when so little was known of prehistoric animals. Even at that time, however, the more progressive English anatomists were well able to see the absurdity of Pedder's views.

The preservation of these notes is due to William Clift, who copied them carefully and filed them away. He was at that time Conservator of the Museum of the Royal College of Surgeons, and was Professor Owen's father-in-law. On his notes Clift had added a satirical comment which is an appropriate last word on the subject:

Can it be possible that Jonathan Pedder has racked his brains, and wasted his Time, (and Time means Dollars in America) in concocting this beautiful and philosophical view of his subject, in sober sadness? or does he imagine that his friend and father John Bull's gullet and gullibility are so capacious and accomodating as to *swallow* the World, the Elephant and the Tortoise? by way of opening a passage for receiving fifty miles, or so, of Sea-Serpent?

The later history of these bones must have annoyed Mr. Pedder greatly. His suggestions were discarded with no more attention than they deserved. Owen examined the skeleton as exhibited by Koch, identified it as being a mastodon and of the elephant tribe, and pointed out many errors made by Koch, who, nevertheless, was much nearer the truth than our compatriot Pedder. Later the British Museum acquired the specimen. Completely and carefully reassembled, it still stands in a gallery of the natural history division of that great institution.

Eskimo Dogs—Forgotten Heroes

Showing the intelligence, loyalty, and strength of the Eskimo dog, and the thrills and hardships of dog-driving in the far North

By W. ELMER EKBLAW

THE day of the dog sledge in Arctic exploration seems to be past. That century or more of courageous travel over ice field and glacier which closed with the introduction of the airplane to polar research, constituted a period of brilliant exploit and daring survey of new land that remains unparalleled for hazard, for hardship, and for human perseverance. It was a period of romantic research that pushed back toward the poles the Arctic frontier until there was no "farther north."

A passing mode of travel

The sacrifices, the service, the noble deeds that characterized that period will continue to inspire and challenge youth and manhood until the last record of that glorious past is lost. The lure of the Arctic trail, the mystery of the midnight sun, the majesty of the aurora borealis will ever remain, but that most thrilling phase of polar activity, sledging with dogs over snow field and sea ice, which added so much to the fascination of Arctic exploration in the century past, cannot persist as a means of transport for seeking out new lands, new seas, in competition with the airplane. For the airplane can cover as much territory in a day as the dog sledge can in a whole season.

Yet the passing of the dog sledge marks the end of one of the most delightful, most impelling elements in the lure of the Arctic. Many things will always make the Arctic glorious and attractive: the freedom from petty responsibilities of civilization; the pure air; the healthful food; the freedom from illness and epidemic diseases; the invigorating activity of the chase

by land and sea; the majesty of the landscape; and the sublimity of colorful skies. But the exultation of dashing over new ice, of hearing the rhythmic beat of furred paws and the vibrant ring of steel runners upon frost-felted ice, and of seeing the mirage ever painting new pictures upon the horizon, was lost when dog-driving in exploration ended.

The peoples resident within the polar realms, however, they who make their homes along the desolate Arctic shores, and wrest their living from the niggardly north, must ever cling to the dog, the dog sledge, and dog-driving for getting about on their broad hunting and fishing grounds. They depend upon the dog as their only draft animal, their only means of getting from village to village, from one habitat of game to another, or from the haunts of one kind of game to the feeding grounds of some other kind.

The Eskimo's chief asset

Among the Polar Eskimo of Thule, or Northwestern Greenland, most dependent of all upon their dogs, there is no such thing as wealth, no system of land tenure, of property, or of possession except of a few personal belongings, but prosperity and welfare may be measured in terms of dogs. If a hunter have an adequate number of dogs in good condition, he can sledge far to the haunts of game, wherever they may be, and having made his kill, haul home on his sledge a heavy booty of meat for food, blubber to light and heat his igloo, and skins or furs for clothing his family. His folk are well fed, happy, and healthy; they are dressed warmly and comfortably; their igloo is well lighted and well heated. He is prosperous,

a good hunter. His dogs remain strong and powerful.

On the other hand, if his dogs be so few or so under-nourished as to be inadequate, either through accident or disease, then the Eskimo, no matter how energetic and skillful a hunter he may be, is doomed to poverty until he can rebuild his dog team to sufficiency. While his dogs are few or weak, he cannot travel far, and must confine his hunting to grounds where game is scarce or hard to kill because of over-hunting. When he makes a kill, he cannot overload his sledge because his weakened dogs cannot pull it. His family suffers want—his wife and children and other dependents are under-nourished, their clothing becomes worn and depleted, and his igloo remains cold and gloomy because of lack of blubber for heat and light. His dogs remain half-starved. He is poverty-stricken.

Thus the dog team rigorously determines the economic status of the Polar Eskimo. The resources of his land are sparse and monotonous. He must live by game alone, for meat is his only food, skins and furs are his only clothing, blubber is his only fuel and source of light. He must hunt. He cannot farm, he cannot trade. He cannot engage in the hundred and one businesses of the Southland. He has no grass to feed cattle or sheep or horses, no grain for hogs or poultry.

Supreme in the Arctic

Camels or llamas could not endure such a land as Thule. Cattle of any variety, horses and their kind, and even reindeer, would be of no use on glare sea ice. They could find no footing, and thin ice would not bear their weight. They could not eat fish or flesh. They could not survive without frequent feeding. Even the best of them are not so obedient, so tractable, so sensible, so companionable, and in many ways so self-sufficient, as is the dog. The Arctic decrees that the Eskimo may have no other draft animal than his dog.

For the Eskimo dog is a marvelous adaptation to Far Arctic conditions of terrain and food supply. He is light enough to travel over ice so thin that even man may not venture upon it, and yet he is strong enough to pull a heavy burden by sledge. He lives by flesh alone, the only food available in the Arctic, and because of his wonderful reserve strength, he can go without food for several days and yet draw the sledge

to which he is hitched. He wears a heavy coat of warm hair, warm enough and heavy enough to keep him active and comfortable at temperatures of fifty or more degrees below zero; as long as he is fed regularly about once every three days he can endure the most bitter cold—in fact, revels in it—for weeks on the hardest kind of trail.

Best of all he is intelligent enough to turn every advantage to his own good. He has sense enough to coöperate with his driver in every way that he can. He makes the most of every opportunity for comfort, or rest, or food, whenever it appears. He is loyal, and affectionate, and gentle, happiest when in the harness and on the arduous hunting trail. Though he quarrels constantly and interminably with his fellows in the team, the quarrel is a semi-friendly rivalry, and he never seriously injures his team mates; when occasion arises he pulls together with them as a unit.

Eskimo dogs differ

The dog of the Polar Eskimo is not a true husky. The pure strain of dog which the Polar Eskimo possessed when Parry first encountered them has since been crossed with strains brought into the land by whalers and explorers, and particularly by Peary, who introduced the Newfoundland dog with the deliberate and expressed intent of increasing the size and strength of the Eskimo dog, and accentuating his aptitude for the water environment upon which so much of the driving is done. The resultant breed is a powerful issue of the two strains. Whenever the *singarnok*, as the Eskimo call the dog whose marking and characteristics are typical of the old original strain, appears in a litter, his size and strength are appreciably increased over those of his primitive ancestors, and he is a better dog.

The outstanding attributes of the dog of Thule, the dog of the Polar Eskimo, are his devotion to his driver or master, and his gentleness as compared with the dogs of the Labrador, the Hudson Bay region, and even with the native Alaskan and Aleutian dogs. Very rarely does a Polar Eskimo dog bite or attack any person, or attempt to do so. Much as he quarrels and struggles among his fellows, the dog rarely or never sets upon either children or adults. He dies of starvation and overstrain in the harness, lapping the hand of the driver who is suffering with him and who must desert him

when there is no other course. His driver is his God, and he knows no other.

Maximum efficiency in the team seems to be achieved with eight or ten dogs. Fewer dogs reduce the strength of the team more than proportionally, whereas a larger number of dogs demands more time for hunting to provide sufficient food to keep them in health and fine fettle. The best balance between dogs, efficiency, and food seems to limit the team to eight or ten.

"The king dog"

In every team one superior dog, superior because of strength, intelligence, and fighting ability, establishes his right to supreme authority over the rest of the dogs, and thus becomes "the king dog," by soundly and indisputably trouncing every other male dog in the team. Having once established this authority, he maintains it by going through the team periodically, not over a period of weeks but several times a day, and reasserting his sovereignty by forcing every male dog to turn over on his back and subject himself to the king dog's punishment. The king dog knows no allegiance, no obligation to any but his master, or driver, and to his liege master he is leal and true to the death.

Arrogating to himself the responsibilities as well as the prerogatives of authority and leadership, the king dog maintains order and discipline in the team, and as far as he can interpret them, carries out the wishes and commands of his driver. When a king dog has served long under one driver, he becomes uncannily wise in the ways of the trail and the game, and in anticipating the wishes and purposes of his master. Little driving is necessary on the part of an Eskimo who is blessed with a skillful and intelligent king dog. The king dog keeps the team going.

Among the Polar Eskimo the dogs in a team are driven fan-fashion, that is, with an individual trace back to the sledge from every dog in the team. The traces are of the same length or nearly so, sixteen or eighteen feet long, so that the dogs form a semicircle before the sledge as they pull the sledge forward. The traces are of thong of bearded seal or, when occasion requires, of walrus skin, cut to a surprisingly uniform thickness of about three-eighths or one-half an inch.

Such a system of driving is necessitated by the rough sea ice of the Thule coast, over which by far the greater part of the driving is done,

whether on the fixed icefoot along the shore, or on the broad expanses of the open sea. If the dogs were driven tandem, either singly or in pairs, stretched out in a line of greater or lesser length before the sledge, some of the dogs would be crushed down over a hummock, or swung up over a hollow as the case might be, and the whole team would be stopped. By the Greenland fan-fashion of hitching, each dog picks his own trail, and though a dog or two might be temporarily held up by the traces catching on a block of ice, the rest of the team would keep the sledge moving.

The disadvantages of the fan-fashion hitching are that the dogs on the wings of the team cannot pull forward with their maximum power, and some of their strength is lost; and despite all the efforts of the driver, and with all the skillful and willing coöperation of the king dog, the dogs do weave in and out somewhat among the traces, the traces become tangled, and the sledge must be delayed until the driver succeeds in untangling them. The period of delay is never wholly lost, however, for on salt sea ice, which is never quite dry, the dogs must be permitted occasional opportunity, every hour or two, to bite out from between their paws the balls of packed ice which form there, and, if left, spread the toes so wide as to break the skin, and more or less seriously lame the dogs.

Guiding the team

The driver uses a long whip, many feet in length, with a handle not over one and one-half to two feet long, and with a lash about half an inch thick at its attachment to the handle and tapering down well nigh to wrapping cord thickness at the last yard or two—the cracker. The lash is skillfully cut and prepared from the finest tanned skin of the bearded seal, and the fine cracker thong is as smooth and uniformly thin as the best braided textile cord. In windy weather, or with a poorly disciplined team, when the whip must be used rather constantly, the cracker snaps off, a foot or more with each lash of the whip, and must be frequently replaced.

"Huk, Huk," and cracking the whip over the dogs is the signal for starting the dogs. The team is turned to the right by calling "Atch-ook, Atch-ook" and cracking the whip to the left. It is turned to the left by calling "Howie, Howie" and cracking the whip to the right. It

is stopped by an indrawn whistle and cracking the whip before the dogs—they do not always stop, when a bear or seal is in scent!

An ingenious arrangement of strips of ringed seal skin, generally with the hair left on, forms the harness. A band passes about the dog's neck and from that band strips run over his back, and between his front legs and up along his sides to the place where the trace is attached. The dogs never chafe from this harness, and seem never to be choked or in any wise affected by the band about the neck. The harness must be kept fairly soft and pliable and lasts many months. Because, when dog feed is scarce, the dogs sometimes chew their harnesses and traces, a supply of thong and skin for repairs must be carried on long trips where the finding and killing of seal is uncertain.

The sledge

Before the white man came to Thule, the Polar Eskimo made his sledge of bone and ivory because he had nothing else to employ for it. Necessarily then his sledge was small and primitive and three or four dogs sufficed to draw it. The prosperity of the Eskimo then was strictly limited by the tiny size of his sledge, and his standard of living was correspondingly lower. When the white man brought lumber for runners and iron or steel for shoes on the runners, the sledges quickly became larger. Today they are from six to eight or ten feet in length, two or more feet wide, and capable of bearing large loads. Heavily laden sledges require more dogs, but they permit longer hunting trips and larger loads of the necessities of life. Consequently, the standard of living has been much improved.

The enlargement of the sledges and the increase in the number of dogs in the team has not, however, resulted in commensurate advance in the standard of living. The extra time and effort required to kill additional game to feed the dogs imposes upon the Eskimo a regime of hunting that occupies almost every moment of every day when weather and ice are favorable for hunting. The need and capacity of the Eskimo dog for food are well known, and the hunter may not neglect any opportunity for making a kill. Much of the supply of dog-food comes from walrus. Seal hunting supplies a secondary supply of dog-meat; while only relatively insignificant stores of dog-food are obtained by the chase of the bear, the caribou, and the smaller creatures.

On the trail in terrain where game is abundant the Polar Eskimo makes a kill and feeds his dogs about every third day. If the quantity of meat from each kill is sufficient, the dogs thrive on such a program, but when game is scarce, they soon show the effects of overtravel on insufficient nourishment. In country with little or no game the Eskimo carries a supply of slabs of frozen walrus meat, the dog-food *par excellence* for the early spring trail over long distances.

Frozen food

The frozen meat is chopped into pieces about as large as a man's fist, and fed to the dogs frozen solid. The dogs gulp it down, as they do all their food, with little or no chewing. When the feeding is over, the projecting corners of every frozen lump can be felt through the skin over the dog's stomach, and the dog lies and shivers for an hour or more until the meat is thawed out and begins to digest. It seems like hard, cruel fare, but the dogs remain healthy and retain their strength best upon such a diet.

The season of sledging ends when the ice becomes rotten and unsafe. During the summer, when the hunters are out on the open sea hunting the much desired walrus, the dogs wander about the tupiks, or sealskin tents, seeking such waste food as the Eskimo cast away. Only occasionally are they fed. They need little food then, for the sun is warm, and they have no work to do. They laze about the sun-warmed rocks and sleep most of the time. Nevertheless, they receive too little food to keep them satisfied, and most of the time they are ravenously hungry. Yet, even so, they are playful though mischievous, never ugly or treacherous, as are similarly half-starved dogs on the Labrador. Fortunately the so-called summer season is brief—it lasts from about June 20 or July 1 to August 20 or September 1.

Most of the puppies are born in the summer, and the Eskimo begin selecting new specimens for replacing old or lost dogs. Training of a dog begins when he is but a puppy. If he develops greater size and strength, or if he shows more than average intelligence, he is even earlier selected for the team and given preference in food and care. He is hitched into the team with older, trained dogs, and in a very short time learns the rudiments of his task and his position. If he measures up to his promise as a puppy, he requires but a few weeks to gain

knowledge of what he must do and what he must refrain from. After taking part in the first kill, he realizes that sledging means the excitement of the chase, and food. Thenceforward he delights in the trail, awaits the harness and his hitching with eagerness, and works co-operatively with his driver and his fellows of the team.

Ancestry of Thule dog

One reason the Greenland dogs are not so vicious as those of the Labrador, and elsewhere, is that they are farther removed from their wolfish ancestors, and do not bear so strong a strain of wolf blood in their veins. For many decades, perhaps for a century, the wolf has been extinct in Thule, and mating between dog and wolf is no longer possible. On the Labrador, and on other parts of the Arctic coasts where the Eskimo live, wolves are still common, and admixture of wolf with dog is a frequent phenomenon. As a consequence, many of the dogs on the Labrador are so treacherous and vicious that it is almost unsafe for a stranger to enter a village there without a club in his hand, or a native escort beside him.

Another reason for the relative gentleness and loyalty of the Polar Eskimo dogs is their undoubted partial Newfoundland ancestry. Altogether the Polar Eskimo dog on his native heath is a most friendly and devoted companion even under the most trying conditions, and not to be feared at any time or season.

Occasionally a particularly attractive puppy is selected as the house, or igloo dog, and becomes the household pet. He is accorded exceptional care and privileges, and though he rarely develops into a good sledge dog, he is given a generous part in the food supply, and treatment as one of the members of the family. Some hunters have little sentiment or sympathy for such pets, feeling that they add an unnecessary burden upon the family larder, and in times of stress, the household pet may find his way into the food supply as readily as any other dog.

In the autumn hunting season women as well as men are too busy to visit other villages, but when the winter season comes and the sun has set below the horizon for the full twenty-four hours of the day, there is a lull in the hunting. Then the sledges are repaired and relashed, the runners are repolished, the harnesses and traces are replaced, the dogs are fed well again, and everybody starts upon a program of neigh-

borly visits from village to village along the whole coast.

And for the dogs, as for the people, it is a time of excitement, of meeting old acquaintances, of seeing new sights, hunting new game. With their tails curled over their backs in the best of health and spirits, the dogs fight gaily and indiscriminately among themselves, apparently reveling in the chance for physical threat and encounter. Such snarling and gnashing and showing of teeth only the wolf packs could equal.

The women are proudly decked out in the new garments they have made through the summer, the hunters boast new whip lashes, new field clothes, and perhaps new hunting equipment. The women have spared enough time from their summer duties to tan very carefully their best furs and skins and sew them into comely costumes for the envy of their relatives. Vanity is as widespread as femininity, it would seem. It is a season of feasting and gossip, of interchange of plans and experiences, of song fests and hunting parties.

Huskies have individuality

The Eskimo dogs vary significantly in their individual qualities and traits. Some are much more conservative and poised than the general run; on the other hand some are so vivacious and excitable that they become difficult of discipline and lack dependability. Very few are surly. Most are responsive, particularly when on the trail. Some are selfish; some greedy. Some are lazy, and they are soon discarded from the team. Some are more quarrelsome than are others. Some are much more courageous and confident of their prowess and ability to care for themselves.

The dogs share with their driver the skill of the trail and chase, but in varying degree. Some dogs are so superior for seal-hunting or for bear-hunting, as to achieve high repute throughout the Polar Eskimo group. A good bear-dog is much to be desired and, when found, is given every consideration. The dogs are trained from puppyhood to hunt bear, and once they have taken part in the excitement of the chase, they are not to be restrained.

When the team crosses the fresh track of a polar bear, the whole team turns as a unit to take up the scent and, no matter how worn and fatigued, dashes off in pursuit. The driver has little choice but to hang on to the sledge with

all his strength, without attempting to control his dogs; for woe betide him if he is tumbled off.

The mad dash for bear

The dogs dash on in wild and eager chase with no thought for their driver. If he fall off, so much lighter the sledge! And it may be a matter of ten, or fifteen, or even more miles before the dogs finally drive the bear into the open water or "tree" him on an iceberg. The driver who does not hang to his sledge may have to trudge all those miles over rough ice, or deep snow, or both, before catching up with his team.

The dogs cannot kill the bear; they merely bait the poor beast and keep him from escaping until the driver despatches him. Usually the dogs are not hurt, for they evade the bear's clutch or the heavy blow of his paws; but occasionally a careless or overdaring dog gets too close to the bear and then he is pretty likely to suffer injury. The driver, when he makes the kill, always gives the dogs a share in the flesh of the bear. Much of the flesh, and of course the heavy pelt, fall to the driver's portion.

The period of a dog's active service in the team depends in part upon the driver. An Eskimo who is considerate of his dogs, who ably looks after their food supply, their health, their comfort, loses but few of his dogs, and drives them five or six years, but rarely more, before they fail him. A poor driver or poor hunter loses his dogs through accident or starvation much more quickly.

Yet even the best of hunters may sometimes lose his team or most of it, despite his utmost care and precaution. Epidemic rabies sometimes invades Thule, and then the good dogs, the good teams, suffer as severely as the poorest. Heavy and unexpected fall of soft snow may catch a hunter hundreds of miles out on the trail, and before he can get back, most of his dogs may have succumbed. A sudden change in the wind may break the ice away and carry both dogs and driver out to sea; the driver may return, for he may feed on his dogs, and await the drift of the ice back to land, but the dogs rarely survive.

Man's best friend

The history of the Polar Eskimo is a long record of dependence upon his dog. Hunting upon the ice rather than in open water is the chief activity of this group and for this pursuit, as for the hunting of bear, musk-ox, and caribou, the dog and sledge are essential.

The dog constitutes the final, and perhaps the most important link in the long chain of environmental factors that make human life possible in Thule, a thousand miles within the Arctic circle, and enable the Polar Eskimo to maintain his permanent residence and to live happily within the very shadow of the Pole, on the ultimate frontier of the Arctic.

Perhaps nowhere else in the world is the bond of inter-dependence and loyalty between man and dog stronger than among these people of the North and their dogs!



*Over pack ice.
From Rasmussen's
"People of the
Polar North,"
courtesy of Lippin-
cott*

Eskimo Dogs— Forgotten Heroes

The Eskimo dog of North Greenland is loyal, affectionate, and gentle, happiest when in harness and on the arduous hunting trail



*Photo by
E. M. Weyer, Jr.*

(Below) These dogs are fresh, as their up-curved tails indicate, but if necessary they would die of starvation or overstrain, lapping the hand of their master who suffers with them





EATING (*Above*) Large chunks of frozen walrus meat are gulped down whole. Until they are thawed out in the stomach, one can feel the projecting corners through the skin

WORKING (*Below*) "Huk! Huk!" and a crack of the whip above them is the signal which starts the team. The Polar Eskimos drive their dogs in fan-shaped formation

Photo by E. M. Weyer, Jr.





FIGHTING (*Above*) Every team has a "king dog," which periodically trounces every other male dog in his gang. To his master he is true to the death

RESTING (*Below*) On the salt sea ice. The dogs must be allowed frequently to bite out from between their paws the lumps of packed ice which form there





The dogs weave in and out, causing the traces to become plaited and tangled (insert left). Then the driver must halt, unhitch the sled, and take the necessary time to untangle the lines

(Below) When the team crosses fresh tracks of a polar bear, it dashes off in pursuit. The dogs keep the bear from escaping until the driver brings him down



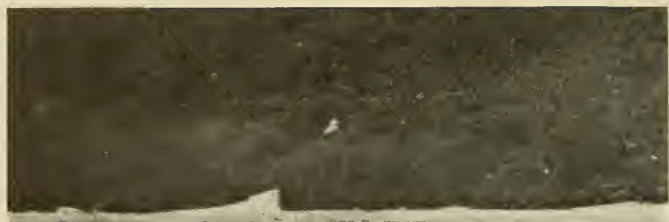


In springtime, lakes appear upon the sea ice. Then there is great splashing, and the driver must watch the depth or he and his load may get soaked. If a line becomes fouled (insert right), one has to go wading in ice-water



(Below) The puppies, like all young dogs, are playful and friendly. Occasionally one of them wins a place as an igloo pet instead of a sledge dog





"What is the man with the box doing?" The dogs at the left are registering curiosity, which is one of their prominent traits



(Right) Training in harness generally begins when the dogs are scarcely more than puppies



(Below) In the lee of a pressure ridge. A heavy coat of warm hair keeps the husky comfortable at fifty below



Science in the Field and in the Laboratory

*The Roosevelt Memorial, Astronomy, Lectures, Health, Meetings
of Societies, New Members*

Edited by A. KATHERINE BERGER

The Roosevelt Memorial Dedicated

The New York State Theodore Roosevelt Memorial Building, perpetuating the life and work of Theodore Roosevelt, was dedicated in the City of New York on Sunday, January 19, 1936, at two o'clock, and its administration delegated to the Trustees of the American Museum. A complete description of the Memorial and the dedication ceremonies will appear in the March issue of NATURAL HISTORY.

Amateur Astronomers Association

On Wednesday, February 5, at the regular meeting of the Amateur Astronomers Association, Dr. Robert I. Wolff, of the department of physics of the College of the City of New York, will speak on the subject "Nebulae."

On Wednesday, February 19, Dr. Jan Schilt, head of the department of astronomy at Columbia University, will talk on "Stars of High Density."

These meetings are open to the public free of charge and are held in the large auditorium of the American Museum at 8:15 P. M.

Planetarium Special Lectures—1936

The first series of special lectures in the Planetarium was received with so much enthusiasm that a second series has been arranged. The six special lectures of the second series are to be given on the second and fourth Wednesdays of each month at 6:00 P. M. in the Planetarium dome, illustrated by means of the Zeiss Projection Instrument with lantern slides and motion pictures. They include: February 26—Earth and Neighbor Worlds

March 11—The Midnight Sun: The Sky at the North Pole

March 25—Spring Constellations of Our Home Sky

April 8—Comets and Meteors

April 22—The Precession of the Equinoxes—
Looking Backward and Forward in Time

May 13—Our Place in the Milky Way Galaxy

These lectures will be given by Dr. Clyde Fisher, curator of astronomy and the Hayden Planetarium. The subscription to the series is \$2.50. Admission to any individual lecture can be had only by subscribing to the entire course.

Lectures at the American Museum

The lectures for the spring season for children of members will be held on alternate Saturday mornings at 10:30 o'clock, as heretofore. The two for February are:

February 15—Thrilling Words and Ways of Birds. By Mr. C. C. Gorst. February 29—Neighbors of Sand and Sea. By Dr. George H. Sherwood.

The lectures for members Thursday evenings at 8:15 o'clock are: February 13—Ethiopians and Their Stronghold. By Dr. W. H. Osgood. February 27—Soil-less Plant Culture. By Mr. Arthur C. Pillsbury.

The spring courses for teachers, given in cooperation with the College of the City of New York, New York University, and Hunter College, open the first week of February. The subjects covered at the College of the City of New York are "The Museum in Elementary Social Studies," "Nature Study," "Health Education," "The Museum in Economic Geography"; at Hunter College, "Nature Study for City Teachers," "The Museum in Elementary Social Studies," "Astronomy"; at New York University, "Astronomy for Teachers."

Full information about these courses may be obtained by addressing Dr. George H. Sherwood, curator of education, at the American Museum.

Six lectures for students in elementary biology and general science will be held on Tuesdays at 3:40 P. M., beginning March 3, with a talk by Dr. Walter Granger on "Exploring for the American Museum". Others are March 17—Penguin Personality. Dr. R. C. Murphy. March 31—Meshie, the Child of a Chimpanzee. Mr. Harry C. Raven. April 21—Audubon, the Bird Lover. Mrs. Grace Fisher Ramsey. May 5—Wild Birds and Their Human Appeal. Mr. Paul B. Mann.

May 19—Are You Going to Camp This Summer? Miss Farida A. Wiley. Five lectures on the "Biology of Man" for students in general and advanced biology are scheduled, viz: March 10—The Thinking Machine. Dr. G. K. Noble. March 24—The Gland Regulating Personality. Dr. G. K. Noble. April 7—Prehistoric Life. Dr. G. G. Simpson. April 28—The Human Machine. Dr. H. J. Clausen. May 12—Heredity and Environment as Factors in Life. Dr. G. C. Wood.

In the Museum Auditorium, Saturday afternoons at 2 o'clock there are free motion pictures. During February these will include: February 1—Vincennes. February 8—Bottom of the World. February 15—Abraham Lincoln. February 22—George Washington. February 29—Wolfe and Montcalm.

Health Instruction for Nurses

For four years groups of nurses from all the outstanding hospitals in New York City and from towns as far away as Middletown, N. Y. have been coming to the American Museum for instruction in Health, Comparative Anatomy, Hormones, etc. Dr. William Lord Smith has been conducting these classes, illustrating his talks with motion pictures on "How Life Begins," "Water Supply," "Pasteurization of Milk," and "Human Circulation and Digestion." The requests for this instruction have been steadily increasing, and in the last six months twenty-four hospitals have sent 578 nurses to the Museum.

The Malvina Hoffman Bronzes

The legends under the two bronze figures of African natives by Malvina Hoffman that appeared on pages 88 and 89 of the January issue of NATURAL HISTORY should have included the fact that these figures were reproductions of originals owned by the Field Museum of Natural History, through whose courtesy Mr. George A. Pratt purchased the bronzes.

The American Polar Society

The first annual meeting of the American Polar Society was held on Monday evening, November 25, at the American Museum. Mr. Paul A. Siple, president of the Society, presided. In addition to telling briefly of his experiences in Marie Byrd Land, Mr. Siple discussed some of the problems Lincoln Ellsworth would face if he landed before reaching Little America on his latest Antarctic flight.

Mr. Joerg of the Executive Board, the polar expert of the American Geographical Society spoke on the Arctic work of the late General A. W. Greely.

The entire membership then spent some time seeing the polar material in the Museum.

Just about one year ago (November 29, 1934) a group of friends and relatives of men who were then exploring in the Antarctic with Admiral Byrd and with Dr. Lincoln Ellsworth, formed the American Polar Society to band together all persons interested in the exploration of the polar regions, in order to act as an American clearing house of polar information, to be of aid to organizers and members of polar expeditions, and to spread knowledge of the polar regions.

Toward this end the American Polar Society is collecting books, reports, maps, photographs, etc., relating to the polar regions. The Society keeps in close touch with the Scott Polar Research Institute in Cambridge, England, the New Zealand Antarctic Society, the Arctic Institute at Leningrad, and other groups throughout the world interested in polar matters.

The Society has among its members, who live in twenty-two states and seven foreign lands, men who served in the polar regions under Admiral Robert E. Peary, Capt. Robert Falcon Scott, Sir Ernest Shackleton, Admiral Richard E. Byrd, Dr. Lincoln Ellsworth, and Dr. Jean B. Charcot. Doctor Charcot, himself a member, is the sixty-nine-year-old French polar explorer who sails to Greenland each summer in his sailing vessel, the "Pourquoi Pas?" in which he led two Antarctic expeditions in 1908 and 1910.

In addition to Mr. Siple, the president, the officers of the Society are: Russell J. Walrath of Westfield, N. J., chief cartographer of *The New York Times*, who is vice-president; August Horowitz of New York City, editor of the Society's twice-yearly publication, *The Polar Times*, secretary, and Marshall S. Delavan of Mt. Vernon, N. Y., treasurer.

The Society's Executive Board consists of Dr. Lincoln Ellsworth, who was co-leader with Roald Amundsen in the dirigible "Norge" on its successful flight from Spitsbergen to the North Pole and thence to Alaska (in 1926) and who last fall flew about 2100 miles with his pilot, Herbert Hollick-Kenyon, across the Antarctic Continent from Dundee Island on the Weddell Sea to a point twenty miles from Little America on the Ross Sea; W. L. G. Joerg, polar expert of the American Geographical Society of New York; Dr. Hugh Robert Mill, Great Britain's eminent Antarctic historian; Prof. Frank Debenham, director of the Scott Polar Research Institute of Cambridge, England, who in 1910-1913 was geologist on Captain Scott's last Antarctic expedition; Henry Woodhouse of New York, president of the Aërial League of America; Fred E. Meinholdt, director of Communications of *The New York Times*; Charles Gill Morgan of Dallas, Texas, geologist of the recent Byrd Antarctic Expedition; B. A. Heim binder, Miss Lorene K. Fox, and C. Walter

Seamans, all of New York, and Donald H. Cooper and Miss Margaret McGrain, both of Washington, D. C.

August Horowitz besides fulfilling the duties of secretary of the American Polar Society, is editor of *The Polar Times*, official organ of the Society, which is published twice a year. Associated with August Horowitz on *The Polar Times* as art editor is Herbert R. Loges of New York City. For eighteen months during the recent Byrd and Ellsworth Antarctic Expeditions these two men published a monthly newspaper, the *Little*

America Times, for friends and relatives of the explorers with the Byrd and Ellsworth parties.

The Society holds its meetings at the American Museum of Natural History, its official mailing address. At least two Society meetings are planned each year, in addition to the annual meeting. The membership fee is one dollar a year.

Paul A. Siple, of Erie, Pennsylvania, nationally prominent in the Boy Scout movement, and chief biologist of the recent Byrd Antarctic Expedition, was elected president of the Society in October, 1935.

RECENTLY ELECTED MEMBERS

A REPORT from the membership department lists the following persons who have been elected members of the American Museum:

Life Members

Messrs. William A. Chryst, Otto H. Hafner, Arthur S. Litten, Wesley W. S. Mueller

Sustaining Members

Mrs. Wortham James

Dr. J. C. Burnett

Messrs. William A. Aycrigg, Robert H. Thayer.

Annual Members

Mesdames Miner D. Cray, W. G. Elmslie, W. D. Gregory, Stoddard Johnston, Dean Mathey, R. E. McCormick, C. P. Meadowcroft, James C. Rea, Hannah T. Vosper.

Sister Mary Oswin

Misses Elizabeth Achelis, Frances Achilles, Ruth T. Fitzell, Ella E. Geughof, Johanna M. Topkins, Margaret A. Lindquist, Esther C. Olsen, Charlotte C. Pardee, Charlotte C. Swan, Eleanor Tobias, Evelyn van Duyn, Mildred S. Wolf.

Doctors David C. Bull, Glenn H. Whitson.

Messrs. Hilton E. Alexander, Thomas Barbour, R. C. Bergmann, Harry Templeton Birney, Arthur Bodenstein, Ben Branch, H. Vinton Coes, Jr., Langdon Davis, Lewis L. Eldred, Howard Gillespy, Morrill Goddard, Jr., David Goodale, William M. Kern, Alfred M. Lindau, John J. McDonald, Thomas McGivern, William Maul Measey, Charles E. Merrill, Charles Cobleigh O'Boyle, Frank L. O'Connell, G. E. Prentice, Esle F. Randolph, W. Maxwell Reed, William A. Saunders, J. Louis Schaefer, F. D. Sparre, Robert E. Strawbridge, Howard L. Tiger, Leo Van Uittenbroek, John B. Warnock, Carl Weisl, Jr., Frank D. Whalen, Roger B. Williams, Jr.

Associate Members

Mesdames William H. Arnold, George C. Barclay, Horace Binney, Austin Dunham Boss, W. D. Bostick, William H. Button, Jr., W. E. Capron, Fred L. Chapman, Clarence N. Cook, Esther Cory, Helen V. T. Duvinage, Henry C. Foster, Germaine Ga Nun, Matilda K. Gilbreath, B. J. Graham, Suzu Hospbori, Charles Kingsley, Frederic M. Langdon, Enard Leach, Helen G. Leonard, Edward G. Love, Rose V. Lowell, George Lueders, Walter Lyons, A. J. Manville, A. Hyatt Mayor,

Ronald McCall, Velma Moore, E. J. Mordick, Lucile Wakefield Neuswanger, Alice L. Palmer, Jessie L. Pape, Hattie Pascual, Jessie B. Patterson, Frederika P. Phillips, Palmer Rogers, Charles Schmaling, Feron Shannon, Alfred L. Shapleigh, Julia K. Shauer, Anthony Smith, Peter Smith, John N. Tonnele, Lawrence Tower, Rawson C. Tukey, Thomas A. Turner, Charles B. Voorhis, Brinton L. Warner, Wm. J. Wickes, Margaret S. Wiggin, W. O. Winston, C. H. Woodruff, T. R. B. Wright.

Sisters M. David, M. Sylvia.

Misses Anne Alexander, M. Laura Anderson, Sylvia V. Anderson, Cecily H. Barker, Eleanor M. Bauer, Helen Baxter, Betsey Bean, Sarah E. Blanchard, Anna E. Brobson, Helen Miller Bunce, R. C. D. Burger, E. Alva Campbell, Amalie Castro, Irene W. Chappelka, Elizabeth Cheetham, Jean Childs, Margaret D. Chubb, Grace Coe, Mary Cummings, Florence Dandridge, Edna M. Deats, Jeanne de Lanux, Alice Bunner Dimock, Frances A. Duncan, Elizabeth Eiselen, Gloria Eksergian, Mabel A. Farnsworth, Abbie Flaherty, Ellen A. Freeman, Sarah March Freeman, Ellin Frowenfeld, Sallie Frowenfeld, Edith M. Godfrey, Mabel C. Graham, Catharine R. Griswold, Marion Hall, Mary Winona Hill, Lucy M. Howard, Lois M. Hutchings, Mary E. LaBour, Olive Larkin, Adelaide I. Lawrence, Sylvia H. Lee, Marion L. Leonard, Jane E. Luckings, Margaret F. Madden, Mabel Florence Martin, Isabel W. McCarty, Jennie McCutchan, Ida V. McDonald, Matilda J. McKeown, Marion McMaster, Florence Middleton, Charlotte A. Moore, Madeleine M. Munn, Patricia Munson, Ann Murphy, Lucinda Netting, Rosamunda B. Nonnenmacher, Anna Marie Oaskowska, Helen J. Paine, Vera Pinnelli, Elizabeth Pullman, Louise Riedell, Ethel Rispin, Agnes Robinson, Grace Rotzel, Bessie E. Rowe, Reba Stone, Lilian E. Terry, Katherine M. Thomas, Virginia Thomas, Jenny Torriore, Martha Townsend, Mary D. Uline, Anne Van Santvoord, G. Anna Ver Planck, Charlotte Feng Veshi, Resia Vincent, Betty Waldbauer, Elizabeth Watson, Helen Field Watson, Dorothy E. Wheatley, Blanche R. Williams, Emma Williamson, Ida F. Wright.

Dean Bertha Richards

Reverends George G. Bruce, R. L. Carson, William A. Dumont.

Colonel A. P. Shirley

Majors John V. Bouvier, Jr., George H. Foster.

Captain M. C. Moore

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Reviews of New Books

Animal Photographs, American Trees, Exploration, Birds and the War

WILD ANIMALS. Edited by Helen Sidebotham. *Life and Art in Photograph*, No. 6. Oxford University Press, \$2.00. 100 plates.

THIS is a volume composed entirely of half-tones pictures which carry short captions. There is a brief introduction by the author who states "The aim of this book is to give a glimpse of life in the wild and to show how animals look in their natural surroundings." The difficulties of photographing wild life in its natural environment are contrasted with the ease of securing photographic records in the Zoo. The net result of a careful reading of the introduction is to prepare one for unusual and bona fide photographs.

There are a number of very excellent illustrations in this volume and the names of well-known photographers vouch for the authenticity of many of these. The selection is world-wide in its scope, and the subjects are all mammals, the author apparently preferring the popular designation of "animals" to the more precise terminology of "mammals" which would exclude the birds, reptiles, fishes, etc.

It is to be deplored that this volume has not lived up completely to the high standard set by the work of some of the contributors, and that the departure from this high standard goes so far as to bring in faked pictures. Plate 11 (Puma leaping on prey) is such an illustration, and the history of this photograph was given in *Nature Magazine* for December, 1934. It is quite obvious to any one who has studied or photographed wild life that a photograph of a puma launched in mid air upon unsuspecting deer must by the very nature of things be a "fake."

Plate 96 of the Himalayan Goat which, by the way, is our own North American Rocky Mountain goat, not only discloses a lack of knowledge of mammal life on the part of the editor, but also shows what can be done by posing a mounted specimen in a naturalistic surrounding. Plate 61 is captioned "Young Moose or Elk (America and Europe)" which is very misleading to an American audience since the animal obviously cannot be both. The Duck-bill Platypus is given New Guinea as a homeland, where it has never been taken, and the veriest tyro in nature study should know that this is a classic representative of Australian wild life. Plate

64 purports to show a herd of reindeer or caribou, but the animals are obviously wapiti or, to the American sportsman, elk.

Some of the photographs have all the appearance of having been taken in zoölogical gardens. To attempt to go into these in detail might create an impression which would be unfair to the many interesting and bona fide wild life photographs in the volume. The reader of this book is cautioned to employ his powers of discrimination and not to take too much for granted.—H. E. ANTHONY

SOME AMERICAN TREES. By William B. Werthner; *The Macmillan Company, New York, 1935, 398 pp.; \$5.00.*

THE majority of books relating to botanical subjects are designed as technical references and not as pleasant reading material. This is inescapable, of course, for the study of botany presents endless ramifications wherein a single family of plants often demands volumes of descriptive writing to aid the student.

Doctor Werthner possesses the faculty of successfully combining definite information with delightful reminiscences of hours spent in forest and park, among his friends, the trees. His book will open the eyes of many to the recreational and educational values of objective walks through the woods.

Trees will become friends to be greeted anew upon successive open-air excursions. Shagbark hickory, with its ragged coat of bark, and the wild plum, covered with lacy white blossoms, will abandon their place in the landscape and step forth to be acknowledged. Various beauties will meet the trampler's eye as he seeks the orange and red berries of the bittersweet, and the robins and cedar waxwings in the hackberry at different seasons of the year.

Detailed descriptions of buds, twigs, leaves, and fruit are interspersed with sketches of the commercial values of trees. One learns of the farm boys' use of woodland products, too. The author recalls his mother's rose-colored sassafras tea, the ingredients for which he collected in the woods at the edge of town. Then there is the colorful touch given by flowering dogwoods to a green hillside,

the smouldering red and yellow torches of the maples bursting into flame at the coming of frost.

Doctor Werthner died before his book was completed. Readers will owe a debt to his wife who carried on the work and succeeded in having it published. The vicinity of Dayton, Ohio, is the region included in the book, though many of the trees range throughout the country. The author evidently had his friends and neighbors in mind, for he mentions numerous definite Ohio localities. However, the descriptions are so vividly written that readers in California and Maine will enjoy and visualize them.

A summary condenses recognizable features of each species into a few easily recalled "earmarks," as Doctor Werthner expresses it. This is an excellent book for the identification of trees in winter and summer and for its three hundred photographs by the author to show numerous details of structure. Nature workers in all fields will appreciate *Some American Trees*.—KENNETH M. LEWIS

THIS BUSINESS OF EXPLORING. By Roy Chapman Andrews; G. P. Putnam's Sons, New York, 1935. 288 pages, 31 photographs, and a relief map of Mongolia. \$3.50.

DOCTOR ANDREWS here adds another book to his already rather long list of volumes on exploration and adventure in various parts of the world. Here again we find his stories told with the same simplicity, directness, and enthusiasm which have characterized his other books and made them such good reading and which, through the spoken word, have made him one of the most popular men on the American lecture platform during the past ten years.

The present book is divided into two sections; the first half is made up of various stories drawn from the author's rich experience. Some of these stories are new and some are reprinted from magazines in which they first appeared. The second half deals entirely with the explorations of the Central Asiatic Expeditions in Mongolia during the years 1928 and 1930, and supplements and completes the account of these Expeditions begun in the book *On the Trail of Ancient Man*, which dealt with the earlier years of that exploration.

The first chapter, entitled "Exploritis," deals with the generalities of exploration. There are, the author says, but few areas left on the face of the earth which have not been visited, written about, and mapped, but there are vast areas which are still open to intensive scientific exploration—the exploration of the future. Not only has the type of work changed, but the methods of doing it are changing rapidly. The motor car and the aeroplane are in many regions taking the place of the camel caravan, the canoe, and the native carrier.

Doctor Andrews takes occasion in this chapter to answer the often made inquiry by boys and

young men "How can I be an explorer?" and his answer is "Train yourself for a technical or scientific job which fits into exploration," and he wisely adds the caution that the glamour of exploration is usually dispelled as soon as the party takes the field and there must be something back of the successful field man besides a mere desire for adventure.

The dangers of exploration are treated in another chapter, and while the author is the last man in the world not to make the most of any unusual or exciting incident, he sums up his real attitude on this subject by the statement that he always feels much safer in the heart of the Gobi than on the streets of New York City—a feeling shared by the present reviewer.

Other chapters in this first section include an excellent dog story—the story of the police dog "Wolf" who accompanied the party into Mongolia on three occasions; and there is a touching tribute to MacKenzie Young, who, as chief of motor transport of the Central Asiatic Expeditions for four years, piloted us through many difficulties and who had more real exciting adventures and suffered more real hardships than anyone else in the party, only to meet a mysterious and untimely death in northern California after it was all over.

The second part of the book is a straight narrative of the last two years of exploration in Mongolia by the Central Asiatic Expeditions. It tells of the ever increasing political difficulties encountered in Peking, difficulties which finally became insurmountable and brought this great exploratory work to a close at the end of the 1930 season. Here again are stories of sand-storms, of the menace of bandits, of the reaching out into new territory, both to the East and the West, and of those daily happenings both on the trail and in camp which made life in the Gobi anything but monotonous. There are also accounts of the new discoveries of creatures which inhabited Mongolia in the geologic past including those two extraordinary animals—the battering-ram-nosed titanotherium and the shovel-tusked mastodon, and one chapter is devoted to additional finds of that giant of all land mammals—the *Baluchitherium*.

The volume closes with two appendices: one of them tells briefly the story of those Neolithic inhabitants of the Gobi known as the Dune Dwellers, and the other summarizes the results of the Central Asiatic Expeditions over its ten years of work in China and Mongolia.

Most of the stories in this volume I have heard before, in fact I have lived many of them with the author, and yet I have read them all again with keen and renewed interest because they are told with that vitality and enthusiasm which makes Doctor Andrews an inspiring leader as well as a virile writer. It is this spirit which has created in so many of the youths of the country a burning desire to go and do likewise.—W. G.

IN *Birds and the War*, Mr. Gladstone has given us numerous stories regarding the effect of war upon the bird life within the region of conflict in France and in other countries where fighting took place during the great war. We often read of the use of the homing pigeon to carry messages, particularly in times of war. Thousands of them were used for this purpose during the World War. At the beginning they were thought to be obsolete as conveyors of messages. It was soon found that there were numerous times when a pigeon succeeded in reaching its loft with an important message after telephone and telegraph had failed or could not be used. The information, when written and folded, was placed in a little metal capsule which was attached to the bird's leg. When the bird reached its home loft, it crept inside. Its weight pressed on the platform within, which completed an electric current, ringing a bell that announced its arrival. Some of them have been known to fly as far as three hundred miles. They usually were allowed to make only one flight a week. If they were wounded they were immediately pensioned off, fed well, and became great pets.

The Pigeon Service was used on sea as well as on land. At one time an English seaplane was forced down in the North Sea and was in danger of being dashed to pieces by the heavy waves. A pigeon was released and in twenty-two minutes it had flown twenty-two miles; help was sent at once, and the airmen were found clinging to the wreckage of their ship.

Pigeons were not the only birds used during the war to convey various kinds of messages. Parrots proved to be very sensitive to noise and would set up a chatter announcing the approach of aircraft fully twenty minutes before human ears could detect it. They could not, however, note the difference between the hostile and friendly airplanes, so their use was not so extensive. Canaries, we know, are used in mines today to detect the presence of gas. They were almost unfailing in their warning on the battlefields, and they were used in large numbers. Their limp little bodies would be lying at the bottom of the cage before a man was scarcely affected by the enemy's poisonous gas. They were also taken along when tunneling was being done to detect any subterranean gas. The soldiers made great pets of them and kept them in the safest places possible.

Many soldiers found great interest and comfort in watching the wild bird life about the trenches

on the front lines. One would surely think that wild life of all sorts would flee from such a dangerous zone. This was not true, however, of the birds. They seemed for the most part plentiful and unconcerned. They arrived in the spring, nested, cared for their young, and departed in the fall as was their usual wont. They seemed indifferent to the noise of battle. In "No-man's Land" birds were everywhere, even more numerous than before.

It was noted that nightingales sang even more sweetly, if possible, in the war zone than ever before. In spite of the deafening noise of a violent cannonade one night, a nightingale sat in the shelter of a hawthorn bush and sang gaily through it all, never pausing till the dawn. It was found that his mate had a nest in the bush and was sitting on her eggs, apparently undisturbed by the uproar.

Warblers and other birds built their nests with calm indifference amid heavy firing, and reared their little broods as usual. Sparrows were especially fond of building in old wagons not in use. Swallows placed their nests comfortably in dugouts. Little chaffinches considered wire entanglements ideal places to nest when their briar hedges had been torn away. They could be heard singing whenever there was a lull in the almost incessant firing. Storks also seemed indifferent to the guns and returned to old nesting places on the ruined buildings as usual. Wild ducks and swans followed their usual habits of feeding and nesting with no regard for bursting shells.

The soldiers were generally kind to birds, proving that all was not brutality in the war. An officer once stood for half an hour beside a plover's nest to prevent the eggs from being damaged by the passing troops. They were often heard comparing notes on their observations of birds and they cared for nests they happened to find.

Similar reports of bird reactions to the war came from other battle fronts, Italy, Palestine, and Macedonia. Some claim has been made that the migration routes of various birds were changed to avoid the areas over the battlefields. The author believes, however, there is sufficient evidence in the presence of all sorts of birds in the battle regions that this contention is not true. He believes the birds throughout the war followed their usual instinctive habits as always, with slight adaptations to the changed local conditions.

—LENA MAE POOLE

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ROLAND

On December 30, 1935, Roland, the three-ton sea elephant who was the pride of the Berlin Zoo, died. German children who had developed a particular affection for the mighty creature mourned

him throughout the land. Many believed that the sea colossus passed away because of a broken heart, for the Berlin Zoo could not afford to provide him with a mate

Kent's Island—Outpost of Science

An expedition of Bowdoin College undergraduates establishes a scientific station on a lonely island in the Bay of Fundy

By W. A. O. GROSS

*Field Director,
Kent's Island Research Station*

IT was during the eighteenth century that a certain John Kent, a British subject freshly arrived from England, settled on the island in the Bay of Fundy that today bears his name. John Kent prospered; both the sea and the island's rich soil were good providers. Stark tragedy, however, was to be the fate of many of his successors.

A changed island

Indeed, natives of the region will tell you that Kent's widow had once prophesied that no one would thrive on the island after her death. She was a strange old woman, that widow of Kent's. From another anecdote we gather that she must have been of frightful appearance during her last years. An English brig, according to the story, was making its way up the fog-bound bay. The vessel's captain, who had been over-indulging in Jamaica rum during the course of the day, took over the helm as the little ship neared the "graveyard of the Bay of Fundy," the Murr Ledges. In his stupor the captain claimed he saw a witch guiding him and telling him that with her protection he could sail *through* the dangerous reefs. He took the "witch's" advice, and it was not long before the ship was on the rocks and sinking rapidly. The mariners lowered their small boats and made for Kent's Island near by. Entering the old homestead of John Kent, the captain espied the old widow

and swore that there was the very "she devil" that had betrayed him. It never occurred to him that the rum was the real traitor, and he would have brought the old lady to a violent end had not his shipmates stayed his hand.

Today the tombstones of the Kent family are gaunt reminders of other days. The fertile acres have given way long since to weeds and undergrowth. Even the island's shape has changed. Storm and tide have left their mark. A reconstruction of the island's former geographical features exhibits a harbor and a great extent of land that is non-existent today. An old lime kiln is slowly marching to the sea as soil erosion narrows its distance from the water's edge.

New land for naturalists

The years passed, but prosperity had evidently gone with the death of Kent's wife. The house was burned, a Frenchman was killed, and a ship was wrecked on the southern end. It seemed that the island was a fit home for nothing save the wild life. While offering little inducement for would-be settlers, Kent's and other near-by islands attract to their shores many species of birds including forms that generally nest much farther north. Such types as the petrel, a mysterious wanderer of the ocean; the puffin, a "feathered clown" with a gaily colored, parrot-like bill; the razor-billed auk, surviving cousin of the extinct great auk; guillemots, a doughty tribe of the rocks; and the eider duck, whose down has filled many a feather bed, have thrived on these outer sea islands.

During the summer months of 1934 I camped on Kent's Island with three fellow-students from Bowdoin College. For three months we reveled in the great bird rookeries, in the teeming life of the lagoons offshore, in the beauty of the region, and in our discovery of a land that the naturalist had apparently overlooked. We had many exciting experiences. One time the Canadian Coast Guard boat had to go to the rescue of two of our number when our canoe capsized several miles offshore. At the end of the summer the schooner "Bowdoin" with the Bowdoin-Mac-Millan Arctic Expedition stopped at the island on its return from the north and gave us transportation back to Portland, Maine.

A new enterprise launched

Our preliminary survey had proved so satisfactory that we believed sufficient support could be aroused to establish a permanent research base at Kent's Island. The infant enterprise got a good start through the generous gift of Mr. J. Sterling Rockefeller, who offered to the college both the island and much of the necessary equipment for a field laboratory. With such an excellent beginning, it was easy to rally many friends to our cause. Under the leadership of two Bowdoin alumni, Messrs. Sumner T. Pike and Albert T. Gould, funds were raised to begin the project. The growth of our plans hardly kept pace with the increasing interest in the new station. Support came from everywhere: from scientists, from the alumni and undergraduates of the college, and from many business houses. Burnham and Morrill of Portland offered us food supplies. Gasoline came from the Standard Oil Company. The Collins Radio Company lent us the finest medium-power transmitter available, and other concerns also gave us invaluable assistance.

It was finally decided that the expedition should consist of ten undergraduates and someone familiar with the Bay of Fundy. The latter would be the permanent year-round warden of the station. For this position we were fortunate in securing the services of Mr. Ernest Joy, a native of Grand Manan Island and one who had a remarkable knowledge of bird life as well as extensive navigating experience. The type of students selected were those who had

supplemented their technical training derived from classrooms with actual field work. A highly organized scientific party must have a diversified personnel, a personnel that could carry on studies in many branches of science besides filling the various offices of the self-sufficient field party. Our roster included such positions as commissary officer, cook, radio operator, and boatman, in addition to those that were devoted mainly to research. Such specialization demands that every man carry out the work for which he is personally responsible.

Our main supply depot was located at Lubec, Maine. Through the kindness of Messrs. Alger and Radcliffe Pike, the facilities of their extensive wharf, including storage and office space, were secured for our fitting out in that port. Lubec is a neighbor of Eastport, which is the base of the famed Quoddy Dam operations. We found that the effect of the great undertaking was being felt in full measure. Government employment has made local wages soar; good times have indeed returned to a region that has seen little of prosperity in recent years.

Preparations forged rapidly ahead, and we decided to sail as soon as our last truckload of supplies arrived from Brunswick. In order to have smooth waters for our heavily laden boats we set our sailing time for one o'clock in the morning. Our supplies arrived late at night and, with floodlights playing on the wharf, we finished loading the two forty-foot launches that were to take us to Kent's Island. As the tide was just beginning to come in, we found that our boats were some twenty odd feet below the top of the wharf! Already we were in the throes of Fundy tides.

The great tides

The great tides of the Bay of Fundy are famed throughout the world. At the head of the bay there is a rise and fall of forty-two feet. The rise and fall at Lubec is about twenty-five feet. Such a great range in the ocean's level is equalled only by the tides in Gallegos Bay on the Patagonia coast. It is difficult to appreciate what such a great ebb and flow of the ocean means to the mariner. Imagine having your boat hung up on the wharf by its bow and stern lines when the tide recedes. Imagine anchoring in forty feet of

water and six hours later finding yourself on the dry bottom. Imagine being carried out to sea by the current that nullifies your efforts to row against it. Such experiences, however, are often the lot of the Fundy fisherman.

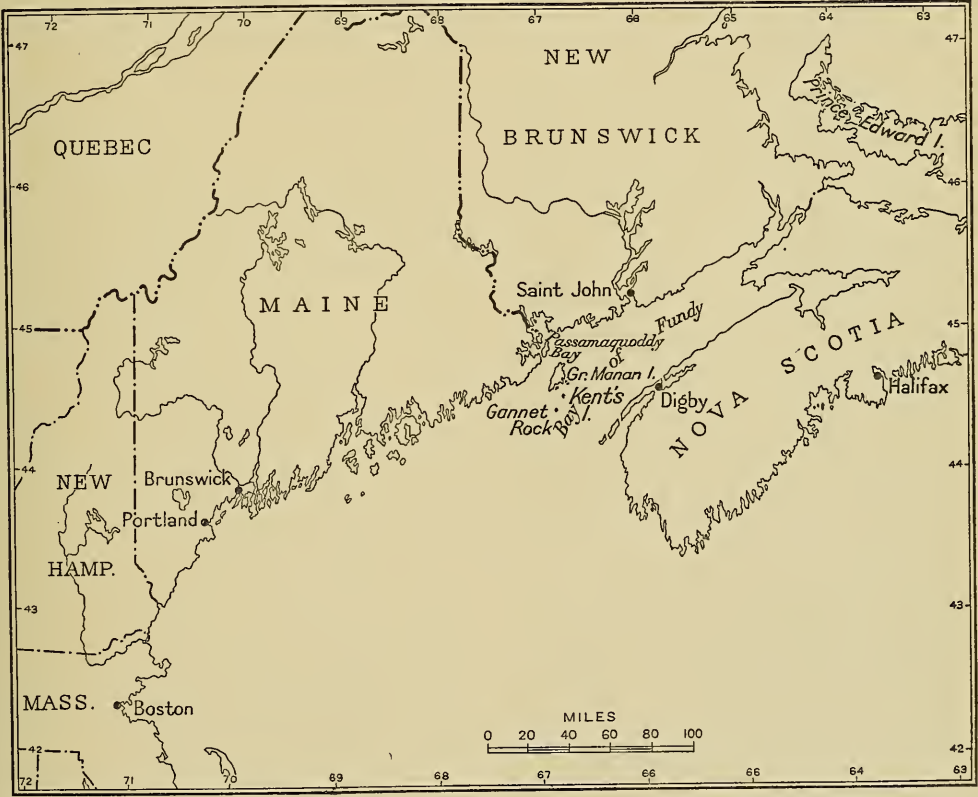
First away was the "Zacatecas," a forty-two-foot, specially built cruising boat which has recently been presented to the station by Mr. Alger W. Pike. At the helm was a skilled skipper who was well versed in the waters of the lower bay. The "Zac" would lead the way; the "Bowdoin II" in the hands of a student crew was to follow. The six-knot tide rushing by the wharf soon spelled plenty of trouble. As soon as we had let our lines go, we swung with a splintering crash into a near-by vessel. After ascertaining that we had done no harm, we manned the boat hooks and put off again. Finally we crept out of the narrows and joined our convoy in midstream.

With our motors roaring a steady note, we

sped down the roads to Quoddy Light and out into the waters of the bay. When we said good-bye to the light at Quoddy Head, we were saying good-bye to the United States for three long months. That dash across the Grand Manan channel was a memorable trip. A brilliant moon rode the sky, and the light on the lead-ship's masthead shone like a star. During half the voyage a great display of the aurora borealis kept us company. The joy of adventure and exploration lived in our hearts that night.

A unique summer home

Only too soon the great three-hundred-foot precipice that flanks the western side of Grand Manan loomed up in the darkness. The very mass of the great cliff, which extends to the south for several miles, almost takes one's breath away. I thought of the poor fishermen who had been wrecked on the ugly rocks at



THE BAY OF FUNDY

Separating Nova Scotia from New Brunswick, is the inlet of the Atlantic Ocean known as the Bay of Fundy. The tides here rise from fifty to seventy feet, and are the highest in the world

the base. We were glad when a few hours later we left this bleak shore and dropped anchor in the peaceful harbor of North Head. After a visit from the Canadian Customs officer, we again headed out to sea, this time for Kent's Island. The island was only a dot on the distant horizon, but excitement was keen. For the first time nine members of the expedition were looking upon what was to be their unique home for the entire summer.

Comfortably settled

As we neared the island, we received a royal reception from the great bird rookeries; the air was soon filled with vast numbers of herring gulls who literally shrieked a welcome. Or was it a challenge? The eider ducks and the guillemots were a pleasant sight. They bobbed below the water as we approached and popped up again after our little flotilla had passed. On occasional rocks seals could be seen basking in the sun. This was God's world; the frontier lay behind us.

From our visit of last year we knew that it would be best to effect our landing at high water and we had timed our arrival accordingly. This would enable us to make use of a tidal basin for unloading. The basin had only one entrance, a narrow passage through which the tide rushed like a mill-race. It was an anxious moment as we eased our boats into the turbulent waters of the channel. With all eyes on the lookout for dangerous rocks, we were virtually swept along by the swift current. The boats maneuvered up to the shore—the first lap was over; we had arrived.

Kent's Island is located about six miles due east of the southern head of Grand Manan, mother isle of the Bay of Fundy archipelago. It is a member of a group of islands that are known on the Government charts as Three Islands. Together they create a perfect natural harbor with three entrances. The largest of the islands—Kent's—measures nearly two miles in length while it is often less than a thousand feet wide. From the water its long flat shape gives it the appearance of a huge airplane carrier. Its strategic position on the great circle route may well make it the location of an emergency landing field of the future; the extensive area in the central portion provides the only suitable landing surface

in the entire bay. The northern end of the island is covered with a heavy growth of virgin spruce, but in the southern sections the inroads of gulls have killed off the forest growth.

We established a temporary camp near the wharf while the headquarters building and dormitories were being made ready for occupancy. There was much to be accomplished. As soon as the electric light plants were operating, we worked until late at night. All of our equipment and food stuffs were carried on a diminutive hand cart over the rough ground to the new quarters. We were favored with good weather, however, and within the course of a few days we were comfortably settled.

Radio masts were erected, and the transmitting equipment was installed without delay. To the delight of the operators the delicate equipment had withstood the rough trip in good condition. The success of the Collins transmitter was immediate; it soon made itself an integral part of the expedition. By the first of July, VE1IN, the expedition's call letters, was a familiar signal to many a short-wave listener.

A link with home

Radio served as our only means of daily communication with the outside world during the entire course of that summer. In one instance the transmitter did valiant service in determining the whereabouts of a fog-bound field party by contacting the Canadian Coast Guard. To facilitate the handling of messages with the United States, daily traffic schedules were arranged with two strategically located stations: W3SN, the army signal corps at Baltimore; and W1JL at West Acton, Massachusetts. Besides handling traffic between members of the expedition and American amateur radio stations, the transmitter, which was used with both voice and telegraph, enabled operators George Cadman and Thomas Gross to have pleasant contacts with stations as far away as Hungary and Russia.

Radio contributed greatly toward maintaining morale. When the island became fog-bound for long periods, the radio "shack" was undoubtedly the most popular room at the headquarters building. Though swirling tides and heavy fog banks might cut off access to

the coast, we could talk at our ease to friends back home.

On the "Bowdoin II," the forty-foot boat attached to the station, a small portable transmitter was installed. The efforts of our active communications department thus enabled us to keep in contact with field parties no matter how far from the island their work might take them.

The expedition's station was probably the only Canadian-licensed, American-operated radio station in existence. This unique permit was granted by the special kindness of the Canadian Government, which has given the greatest coöperation to the new research base.

It seemed to me that Kent's Island had almost been transformed overnight. The simple life of the previous summer was no more. We had such things as electric lights, radio, communication with the mainland, interconnecting telephones, gas stoves, and a substantial library. We could, if we so desired, be entirely self-supporting for at least three months. Our larders were filled with canned foods, and the beach was lined with fuel drums. With three motor boats and our stalwart cruiser in the little harbor—the island's isolation was no more.

Little time was wasted in getting into the field. Blinds were immediately set up in the bird colonies, and daily observations were begun. Since the birds were already nesting, ornithology, for the time being, took precedence over the rest of our scientific projects.

The herring gull

We hoped to throw some light on the status of the herring gull, a sore point with every Maine, Maritime Province, and Labrador fisherman. This species has increased its numbers to such an extent that it is often a nuisance. Formerly faced with extinction, the gulls have profited enormously by government protection. The birds used to be able to secure a sufficient food supply by scavenging, and their economic value in that capacity has been highly praised. Since over-population has set in, they have been forced to resort to such tactics as stealing bait from fishing boats and raiding blueberry fields. They have warred on smaller and weaker forms of life. I have seen such birds as savannah sparrows, petrels,

and eider duck chicks attacked and eaten by half-starved gulls.

Believing that the very balance of nature had perhaps been upset, the United States Biological Survey has taken definite steps to control the herring gull. Their field parties are now making annual cruises along the Maine coast for this purpose. Some fifty thousand gull eggs are being destroyed by piercing the shell with a needle. In these instances the adults continue to sit on the nest although the eggs are sterile. If the eggs are broken or removed from the nest, the bird immediately lays another set. This particular race is able to lay three complete clutches, if necessary, in one season.

A rarity in the bird world

At the southern end of the island, we found the nest of an albino herring gull, a real rarity. This unusual bird had been reported on Kent's Island seven years ago! It is apparently returning each year to its old nesting ground and is today a very conspicuous member of the bird colony. Mating with a normal bird, it had two offspring: an albino and a chick of ordinary color.

Howard Miller, one of our ornithologists, spent most of his efforts in studying another gull species, the black-backed gull. The inroads made by it along our coasts are of great interest to the naturalist. Formerly a bird associated primarily with more northern regions, it is beginning to extend its range to the American seaboard. The black-backed is the king of the gull clan. It is supreme in size, strength, and beauty. Certain individuals often tipped the scales at nearly three pounds (herring gulls average about two pounds), and we have found many birds with wing spreads of more than sixty-five inches.

Despite the fact that on Kent's Island the black-backs are greatly outnumbered by other gulls, they are easily holding their own and are even making yearly gains. We found that no other bird dared encroach upon their nesting territory; the transgressor of this sacred ground is immediately the object of a spirited and effective attack. At the approach of a human being, however, the wary bird stays more aloof than any of the other gulls in the rookery. Courageous but no fool, the

black-backed gull commands the respect of every naturalist that knows him.

Howard Miller kept one of the black-backed chicks at the laboratory for the purposes of study. It soon became the pet of the entire company, the official mascot of the expedition. Mr. Ernest Joy, the good-natured warden of the station, became the unwilling godparent of the awkward youngster, for it was named "Ernest" in his honor. At the end of the summer "Ernest" was crated and taken back to Miller's home in Massachusetts. By that time the young gull had become very large and was a good flyer. One day it made its escape and was given up for lost. A month later, however, a well-known newspaper carried a feature article about a strange bird that had been picked up and that had been made a pet. Miller instantly recognized it for old "Ernest," and he recovered his long-lost bird.

Scouting for guillemots

Meanwhile, Latimer Hyde was engaged in locating the nests of the black guillemots. The homes of these birds were in the recesses of the great rock masses at the southern end of the island. By steering close to the shore in a small boat, we could locate the nests by noting from what places the frightened birds flew. It was impossible to do this from the land because the gulls would cry the alarm if we came within half a mile. The gulls are the sentinels of the bird colonies. The guillemots know by their cries that danger is in the vicinity, and they leave their nests immediately.

Guillemots lay their clutch of two eggs during the first part of July. After twenty-eight days of incubation, a diminutive coal-black chick emerges from the egg peeping the news of its arrival to the world. But it is not always so simple. Storms often wash their way into the home of the guillemots with tragic results. After one particularly strong blow, Hyde found that one-fourth of the colony had been destroyed. In 1934 we built a number of guillemot nests from rocks in the hope of attracting the birds to safer nesting sites. The occupation of these nests was so universal that we are undertaking the construction of a large number in the hope of establishing a larger rookery.

Kent's Island boasts of one of the finest

eider duck colonies along the entire coast. These birds appear early in the spring and begin their courtship performances on ledges near the shore. To film this phase of their life history, it was decided to erect a blind on a large offshore rock, a favorite nesting place of the ducks. Since the surface of this ledge is submerged at high water, the construction of the shelter taxed our ingenuity. But in the due course of time all was in readiness.

We chose a warm day with an incoming tide for photographing as it was more likely that our quarry would be enticed to the rock under those conditions. Two of us went down to the blind, but I alone remained inside. This was a little plot to satisfy the curiosity of the herring gulls. If we had not taken this precaution, they would have realized that somebody was in the blind and would have informed the entire colony of the fact. Being poor mathematicians, they did not appreciate that, whereas two had entered, only one person had left.

I did not have long to wait. As soon as the tide was high enough to make the rock accessible from the water, a large flock of eiders swam up and began to perform nobly in full range of the camera. The striking appearance of the drakes in their full nuptial plumage occupied my rapt attention. I failed to notice that the tide had reached the bottom of the blind! I had to beat a hasty retreat. The ducks had been utterly unaware of my presence, so that when I stepped out, they made a simultaneous dash for the water. Holding my camera on my shoulders, I waded ashore on the slippery, submerged rocks.

"Mother Carey's Chickens"

The petrels, commonly known as "Mother Carey's Chickens," have found a place in the folk lore of many peoples. Sailors in past centuries claimed that, as the birds were never seen near the land, they must lay their eggs at sea and hatch them under their wings. Admiral Byrd found snowy petrels nesting in the antarctic. Alaska is the breeding range for other members of this cosmopolitan family.

Our study of Leach's petrel uncovered many secrets of their lives. The facts which had been unknown proved to be unique. Early in June the male petrels fly in from the ocean,

from journeys that have taken them all over the vast expanse of the Atlantic from the equator to Iceland. This first contingent arrives to construct nesting burrows. These subterranean nests represent considerable engineering skill and industry. They are in tunnel form and often approach a length of three feet or more. This is a remarkable fact because the frail little birds seem to be but poorly equipped physically for such work. After three days of digging, the nest is completed and made ready for occupancy. Courtship follows, and the petrels have a unique one. In the middle of the night the colony, which has been dormant during the day, teems with activity. Females flying over the islands are enticed by the calls of would-be mates from below. By answering each other, they finally effect a union. The pairs of mating birds trill a warm rhythmic series of similar notes during the actual mating. One bird utters the call and the other joins in as soon as its mate has stopped. The calls sound like "mmmmm-mm, mmmmm-mm, mmmmm-mm." These beautiful, contented purrings leave an unforgettable impression with everyone who has heard them.

The incubation of the single white egg occupies both birds for more than forty days. Each bird sits upon the egg for its turn of four consecutive days. During this time it receives no food, sees no light, is not visited by its mate. The newly born chick is an awkward, helpless, little mass of down. It will be at least sixty days before it can leave the depths of the burrow and take to flight. Finally, it is a matter of more than one hundred days of intense effort on the part of each pair of adults to bring a single petrel chick into the outside world!

Persecuted petrels

Petrels seem to be losing ground. Besides having very difficult breeding habits, they are the object of great persecution by natural enemies. Their latest rival in the struggle for existence is the gull, a foe created by the food supply crisis that the latter is facing. One can pick up the regurgitated remains of dozens of birds along the shore after a night of full moonlight. The awkward, erratic flight of the petrels makes them easy prey for the gulls. The latter stand guard in the colonies and exact a heavy toll from the bewildered and de-

fenseless little birds when they come fluttering in from the sea at night.

To test the ability of a gull to swallow adult petrels, an experiment was conducted with a captive black-backed gull. In twenty minutes this bird succeeded in swallowing five birds in their entirety. Little wonder is there then that without adequate protection petrels may vanish from our oceans.

The razor-billed auk

Our interests were not all centered on Kent's Island. Six miles away was a unique colony of razor-billed auks, and another six miles would take us to Machias Seal Island, home of a thriving group of puffins. We planned an excursion on the "Bowdoin II," our floating laboratory, that would include both interests. Because the Murr Ledges took a grim toll of life and ships in the days of sailing vessels, a great lighthouse was placed on near-by Gannet Rock. From the friendly keeper of this isolated post, we received instructions for our visit to the ledges. Only the rocky mass upon which the auks nest remains above high tide, so we were particularly careful in navigating through such dangerous waters. However, the tide was flood; and if our boat should run aground, the rising level of the ocean would soon float it again.

The auks made no pretense of enjoying our visit. Most of the adults took to the air and scolded us roundly. When we succeeded in catching a bird on its nest, we often suffered considerable casualties. They had not been named razor-billed in vain. How they could bite! Full of fight, and wiry creatures to boot, they were a strenuous proposition to handle. They are so much like their departed cousins, the great auk, that clues to the life history of the extinct form are being secured by making studies of this surviving species.

The Atlantic puffin is the most exotic-looking bird of the north. Its keen, spectacled eyes are surpassed in uniqueness only by the dazzling colors and shape of its parrot-like bill. This second feature of its physiognomy has caused the bird to be nicknamed the "sea parrot." Like the auk, it appears in a "full dress suit"; the white feathers of its breast and the black ones of its back and tail present a mock semblance to a white vest, starched shirt,

and tail coat. Its red feet, another distinguishing mark, are matched only by those of another of the alcidæ (family name of the auks, puffins, etc.), the guillemot. At our approach hundreds of puffins took to the air like a great ascension of miniature blimps. Such a comparison is spontaneous; their round bills and solid cigar-shaped bodies practically make small-scale silhouettes of lighter-than-air craft.

We banded ten thousand gulls, besides many birds of other species, on Kent's Island. The recovery of many of these banded birds has already been made. We are finding that the birds of many species return year after year to their same nests. The dispersal of the young herring gulls from the island is also clearly shown by banding records. This group is spreading all over North America. Bands from one-year-old gulls are being returned from points farther north, from western states, and from such distant countries as Cuba.

The sport of bird banding

Banding young gulls soon became routine work. We operated in pairs. One man caught and held the bird while the bander snapped the numbered aluminum ring of the United States Biological Survey on its right foot. Once in our haste we slipped a band on the wrong foot (the left), and when the youngster was released, we noticed that it had a band on each foot! We started in full pursuit. It gained the water and was about to swim out of reach when a big breaker rolled it inshore, and we were able to recapture the very much frightened and over-banded bird.

It was often real sport to capture the adults for banding. Armed with powerful flash lights, two parties would work their way along opposite sides of the island. Made awkward and almost stunned by the bright lights, they were sometimes easy prey, but many a bird led us on an exciting chase over the slippery rocks. The influence of the rays of the lights seemed to have a certain hypnotic effect upon them. In the majority of instances, we could make the birds stand motionless and often walk toward us by shining the light directly into their eyes.

Jacking was used with good results on shore birds. Their migration is in progress during the middle of August, and Kent's Island is directly in one of the lines of flight. The re-

sult is that thousands of these birds use the island as a feeding and resting station. Great flocks would gather in the basin near our wharf on foggy and stormy nights. The tidal flats are a favorite place for feeding at low water, and the depredations of birds upon the crustacea and other low forms of life quite disgusted our invertebrate zoölogist who had hoped for "rich pickings" in that highly accessible spot. When the basin was filled with birds and visibility almost nil, we could often succeed by means of our lights in capturing several hundred of the migratory sandpipers.

The most welcome of the birds are the swallows. Four kinds—cliff, barn, tree, and bank—have established themselves on the island. They are our closest bird friends. Some nest under the eaves of the laboratory, a number bring up their young in the cellar, others occupy the boxes that we have provided, and one species digs holes in the bank along the shore. Aside from an appreciation of their æsthetic qualities, we were well aware of their service in checking the insect population. If the flies and mosquitoes had not been controlled by the swallows, we would have been forced to screen our buildings. One zealous insect chaser even entered my room on four consecutive nights to catch mosquitoes attracted there by the light.

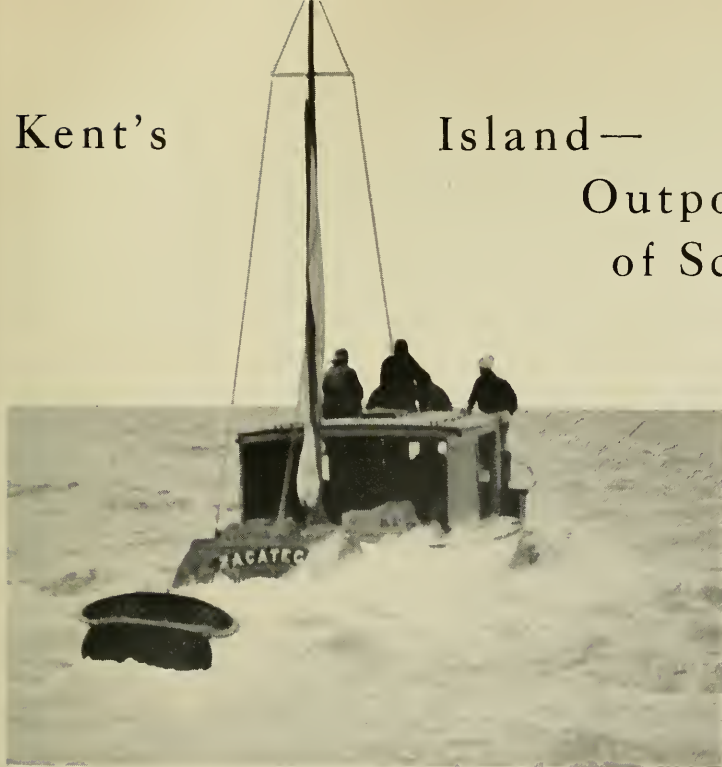
While much stress was laid upon the ornithological aspects of the expedition, we were not idle in other fields of science. Collections were being made of the island's flora and fauna, a base line was laid out by the surveyors, and the meteorologist was busy. For the main part, these preliminary surveys gave every indication that volumes of potential nature lore can well await the naturalist on this fascinating island. Perhaps, too, the studies of the Kent's Island bird colonies will be rivaled by discoveries on the strand and in the depths offshore.

September was soon upon us. The bird population was already changing. The exodus of our breeding birds was followed by great migration flights from the north. Ernest alone would stay on the island during the entire year. There were tears in that kindly man's eyes when he said good-bye. I would not see him again for more than eight months, for we, like the birds, were migrants and had to flee the winter.

Kent's

Island—

Outpost
of Science



The "Zacatecas" leads the little fleet across the Bay of Fundy to Kent's Island. During the night the light on the lead-ship's mast served as a guide for the second boat



Smooth waters are necessary for landing on sea islands, and the dory is the best craft for the purpose



Unloading equipment and supplies for a season's work at the Kent's Island wharf



The top of this tree is covered with a thick growth, solid enough to walk on. Herring gulls trample down the outermost branches of the trees stunting their growth and making them of abnormal shapes



(Left) Removing nestling swallows from their nests for banding



The Kent's Island Express. Scientists have more than one kind of work to perform! The heavy equipment was carted from the wharf to the laboratory in a decrepit two-wheel wagon



(Right) A bird blind made of burlap bagging and drift wood near the high-water mark



(Left) "Ernest," the young black herring gull, not only provided service in the way of scientific data but also supplied an obvious need of every isolated party, the need of a mascot. At the end of the summer Ernest was crated and taken back to Massachusetts. By then he was very large, and a good flyer



(Left) A black-backed gull swallowing an adult petrel. In twenty minutes this gull had swallowed five birds in their entirety



(Left) A rare albino gull standing guard over its offspring: one normal and one albino



(Below) A pair of herring gulls await the arrival of their next offspring. One chick just hatched looks on



(Above) Four freshly hatched eider ducklings make a good-sized handful. These chicks had come from the eggs only a few hours before the photograph was taken

(Right) Members of one of the largest colonies of eider ducks on the Atlantic coast, found on Kent's Island



(Right) A one-day old eider duckling resting on the seaweed after a swim in the cold waters of the Bay of Fundy



Self-portrait of a Leach's petrel. These birds, also called "Mother Carey's Chickens," leave their burrows only at night



A young "Mother Carey's Chicken" which looks like a little ball of down. The one shown at the left was three weeks old

*(Opposite page, right)
A study of a ruddy
billed auk, nearest
living cousin of
now extinct great*

Banding "Mother Carey's Chickens" on Green Island, in a typical petrel colony. Their homes are burrows in the heavy soil



An intricate flashlight camera equipment which automatically photographed the petrels as they left their burrows

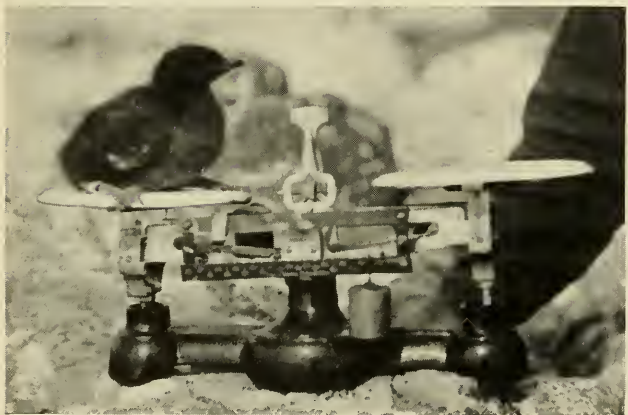




(Above) Black guillemots conceal their nest under great rock masses, so they must be located from the water



(Left) A black guillemot comes up with a rock eel, the result of a successful dive



A young guillemot weighs in. The growth of birds whose life histories were being studied was carefully noted

The Curious Life Habits of the Sea Horse

For centuries naturalists mistook the male sea horse for the female because of a strange reversal in the reproductive functions

By RENÉ THÉVENIN

IT IS easy to understand how a type of fishes so singular in appearance as the *Hippocampi* or sea horses should formerly have been thought of as a group far apart from all others.

The French scientist, Georges Cuvier, created for them (and for their cousins the *Syngnathi* or sea needles) the order of Lophobranchiata. As the name implies, the distinction depended upon the structure of the gills, which in the sea horse grow in the form of tufts instead of in comblike formation as in most other fishes.

Unusual characters

Today it is known that this characteristic of the respiratory system is also found in other fishes in various stages of development. Likewise, the armor of the sea horse which protects its body and which replaces the scales is not absolutely unique. But in spite of these later discoveries which minimized somewhat their strangeness, the *Hippocampi* still deserve special interest because of their unusual appearance and also on account of their life habits. I have the good fortune to illustrate this article with photographs taken from the extraordinary film of my compatriot, Jean Painlevé, which traces in a most expressive manner the principal events in the life of the sea horse.

Sea horses are primarily inhabitants of the warmer seas, though a few representatives may

be found in comparatively cold waters. In Europe, where we studied them especially, they occur as far north as in the Channel. But they begin to be rare in these latitudes, while they are very common in the Mediterranean Sea.

The most abundant varieties do not grow larger than about two inches, but the tropical forms sometimes attain much greater size. In the Australian Seas and also near Japan large specimens occur. The largest are possibly two feet in length.

Like the "knight" in chess

Their appearance also varies, but in general they justify fully the popular name "sea horse." The head of these fishes closely resembles that of a horse, or, even more exactly, the "knight" in the game of chess. Their skin shows no scales but instead a "skin-skeleton," similar to that of the insects. The plates which form this skin-skeleton are connected with each other in rings that give the body of the animal the shape of an irregular polyhedron. One can count fifty-odd such rings from the neck to the lower end of the body. The shields which ride on the back of the fish like the tiles of a roof produce a crest on the head, the neck, and the back. In certain varieties, especially those of the warm seas, these appendages are elongated, overgrown and branched in the most extraordinary fashion, and seemingly for camouflage resemble the marine plants among which the creatures live.

One of the peculiarities of this family is

that unlike all other fishes its members swim in a vertical position. And the tail is not used for propelling the animal at all, but only for gripping a more or less solid support around which it curves itself like a spiral. This support is usually a plant of some sort, but any other object might serve the same purpose. It is easy indeed to have a sea horse clinging to one's finger in an aquarium. To bring this about, it is only necessary to touch its caudal extremity gently. One notices in this instant how much gripping power the little tail of the fish has; it could be compared to that of a small child's hand. The sea horse is the only fish aside from the closely related *Nerophis* that has a prehensile tail. *Nerophis*, of which at least two species are known in Europe only, belongs to the same family as the sea horse.

A vertical posture

The tail is restricted to this use and does not serve as a fin. The anal fin is also reduced to the simplest form and apparently no longer has any function. The fins that are normally found in pairs on the bodies of fishes are represented only by those farthest forward, namely, the pectoral fins, which are placed just behind the gills. They are used to maintain the vertical position and the equilibrium of the body in the water. The only really active fin is the dorsal fin, which oscillates in a rapid, rhythmic manner, reminding one almost of a propeller.

The sea horse does not swim much. Hooked to a bunch of seaweed, it remains motionless in its vertical position; if it does not discard its support it has no exercise at all.

The structure of the head is extraordinary, too. It ends with an elongated snout which opens and closes with a rapid movement. One can distinctly hear the faint smacking sound it makes when it snaps at its prey.

All these characteristics may easily be observed in an aquarium, where sea horses can be kept alive without any difficulty. This at least applies to our native (French) varieties, especially *Hippocampus antiquorum* which is the variety discussed here.

This animal certainly accustoms itself easily to changes in temperature, as well as to changes in the salt content of the water—even to a change of diet. Its food consists, in captivity,

of little shrimps, worms, and even small pieces of meat, which the sea horse catches by a very quick movement of its head the instant they come near its mouth. It is in this moment that one can hear—when listening carefully—the sound produced by the opening of the mouth. The prey is swallowed quickly without being chewed.

In the act of catching its prey the animal is greatly aided by the mobility of its eyes. They are placed on the sides of the head, and are independent of each other. Their way of working reminds one of the eyes of the chameleon. The eyes of the sea horse appear to sense very slight changes of form and illumination.

Light apparently has also an important influence on the general coloration of the body. The color varies not only with the species, but also with the surroundings in which the specimens are found. The commonest color is a dark gray, almost black. But reddish, greenish, and silverish colors are also found; quite often the body shows very brilliant spots. Male specimens sometimes show the dorsal fin rimmed with yellow; the coloration of the females is less pronounced.

When these dark colors turn to a greenish-yellow or even to white, it is a sign of bad health, and the animal usually dies very soon afterward. At the same time the sea horse abandons its vertical position and begins to swim on its side. Sometimes bleedings occur, accompanied by losses of skin which may lead to the loss of parts of the tail. Most frequently all these signs of bad health do not show before it is too late to interfere.

Ascending and descending

When the sea horse descends, it curves its neck and rolls its tail in; when it wants to float upward, it straightens itself out almost completely. It can also creep on the bottom by little movements of body and tail.

The breathing is done, as has already been stated, by means of pufflelike gills. In the moment when the water is inhaled the tongue bones or hyoid bones are erected and poke out the skin from the inside, producing the semblance of little horns.

The rigidity of the skin-skeleton makes it exceedingly easy to preserve the bodies of the

dead sea horses. The mummified little forms are picked up on the shores of the Mediterranean by the children—especially in Naples—and constitute the stock of a minor trade, or, more exactly, an excuse for begging.

Reproduction

But the most interesting thing to observe in sea horses is their manner of reproduction and their way of caring for the young.

In the adult state the female carries about two hundred eggs. When the time has come for mating, the male and female approach each other and begin to make movements which may be compared to a dance.

The male is equipped with a ventral pocket or pouch which extends from the twelfth to the eighteenth ring and has its place underneath the pelvic bone. To be exact, there are two pockets in the skin, right and left, which join in the middle in the adult, leaving only a small slotlike opening.

The female inserts her cloacal appendix into this slot and projects in that way her eggs into the male pouch; while passing the slot they become fecundated. This brings to a conclusion the duties of the mother, and thenceforth the father performs the rôle of a mother—a unique reversal of the usual habits.

When the pouch of the male sea horse is not occupied, it is lined with conjunctive tissue, which is only slightly wrinkled. But from the moment that the eggs are deposited a considerable change takes place. The tissue begins to swell and to grow, it becomes spongelike and the capillary blood vessels enlarge and multiply. In short, placentation is occurring. Interesting speculation surrounds the question as to how the male may have developed this complex function.

Soon after the eggs have entered the pouch each one produces a localized excitation; little holes form, the whole tissue takes on the appearance of a quadrangular network, and each compartment engulfs one egg. In addition, a wall begins to grow from the bottom of the pouch and approaches the seam of the outer skin of the pouch so that it is divided into two parts. Thus two additional surfaces are created which give the remainder of the eggs a chance to secure a place on the pseudo-placental tissue. Those that do not succeed in finding

a place where they can develop, degenerate.

The successful eggs start to develop at once, and as they grow they embrace more and more tissue.

The shell, or rather the skin of each egg splits open inside the pocket, but the embryo is not yet expelled. It rests in the pseudo-placental tissue and remains in this position usually until its yolk is used up almost entirely. During this time it has the curved position of many embryos and does not straighten itself out until it is finally projected into the water.

Sometimes it happens, however, that a few embryos are expelled which are still in possession of a fairly large yolk sac. It is to be noted that these are handicapped in the struggle for existence. The young ones best equipped to meet the dangers of life are those that have freed themselves completely from the natural reserves of the embryonic stage. These also swim in the vertical position at once, the position customary for the sea horses. They even show the adult tilt of the head at once.

Further proof that the connection between the young ones and the father is a very close one can be observed in the fact that the male suffers considerable difficulty in the act of expulsion. He can be seen writhing on the soil, rubbing his body, and struggling energetically. At the same time his eyes are wide open and move convulsively in the rhythm of breathing. Finally, with considerable force the male ejects its burden of young sea horses, the residue of the eggs, pieces of tissue, and many bubbles of gas.

The pouch does not empty all at once. There are several expulsions which may extend over a number of days in the form of consecutive spasms. Even when the pouch is finally empty, the contractions continue for a time, slowly becoming less violent. Finally the pouch is deflated, its slot, wide open during the expulsion, closes again. The tissue in the pouch returns to normal, the network of blood vessels becomes more ample.

Possible accidents

A few accidents may happen during this period. The pouch may close over a comparatively large amount of gases not ejected together with the embryos. These gases, of

course, disturb the buoyancy of the animal. In the aquarium it is easy to catch the specimen and to insert a narrow tube or cannula into the pouch and allow the gas to escape, pressing gently against the sides of the body to expel it.

After the young sea horses can no longer draw from their father or their reserves of yolk they have to seek their nourishment independently by the normal means. Their appearance at this time still varies even with specimens of the same variety, according to the conditions of their birth. Those that are "born" prematurely still carry the burden of their vitelline sac, swimming awkwardly in a horizontal position. In spite of the yolk sac which tends to drag them down to the bottom, they swim near the surface, probably because their still highly developed swim-bladder keeps them afloat.

Physical characters of the young

Their eyes are still very large and remind the observer of the eyes of the embryos still in the egg. On the other hand, the snout is very short and so to speak flattened out over the face. The face looks vaguely like that of a Pekinese dog. The body is still more or less transparent and one can see the tiny heart beating. But soon the first spots of pigmentation begin to appear here and there, in a strange pattern. Slowly the distribution of these spots becomes more regular, and they begin to look like stars. The blots unite and cover the whole surface of the body, which becomes opaque and takes on the coloration of the adult.

Though normally it should occur at the time of birth, sometimes the snout does not protrude until an advance date. But finally the head assumes the adult position at right angles to the body and the animal begins to swim in the vertical position. At the same time the little animal descends deeper into the water and begins to look for a water plant as a support. Quite often, the young ones, misled by limited experience, try to attach them-

selves to non-solid objects such as air bubbles that come from the plants or float on the surface of the water.

The sexual characters do not appear before several months have elapsed. It is not before that time that the forming of the male pouch and the female appendix can be observed. Generally speaking, the animal is not ripe for reproduction before the following year. In our European climate the couples begin to unite in spring, and the events we have described take place sometime in the summer, according to circumstances. The expulsion of the young ones takes place forty to fifty days after fecundation.

These are the curious life habits of the sea horse—life habits which have been known to naturalists for hardly a century. To be sure, the incubation pouch was long ago mentioned by classical authors, but quite naturally it was attributed by them to the female, and careful observation by scientists was necessary to reveal that the opposite condition existed.

The final achievement in elucidating the life habits of the sea horse should perhaps be accredited to Monsieur Jean Painlevé, for it was his skillful studies with the motion picture camera that made it possible for the man in the street to observe and understand them.

Early records

The first person to observe the intertwining of sea horses in the act of transferring the eggs was probably Dufosse, a Frenchman, in 1854. He published his description in 1874; and in the same year Fanzago, in the zoölogical station in Naples, observed the same process. In 1867 Lockwood, an American, saw the delivery of the young.

Huot, another Frenchman, published in 1902 a paper in which he showed sections through the egg pouch, and showed that the epithelium makes nests surrounding each egg and that the network of blood vessels supplies nourishment to the eggs by osmosis. Cohn extended and confirmed Huot's observation.

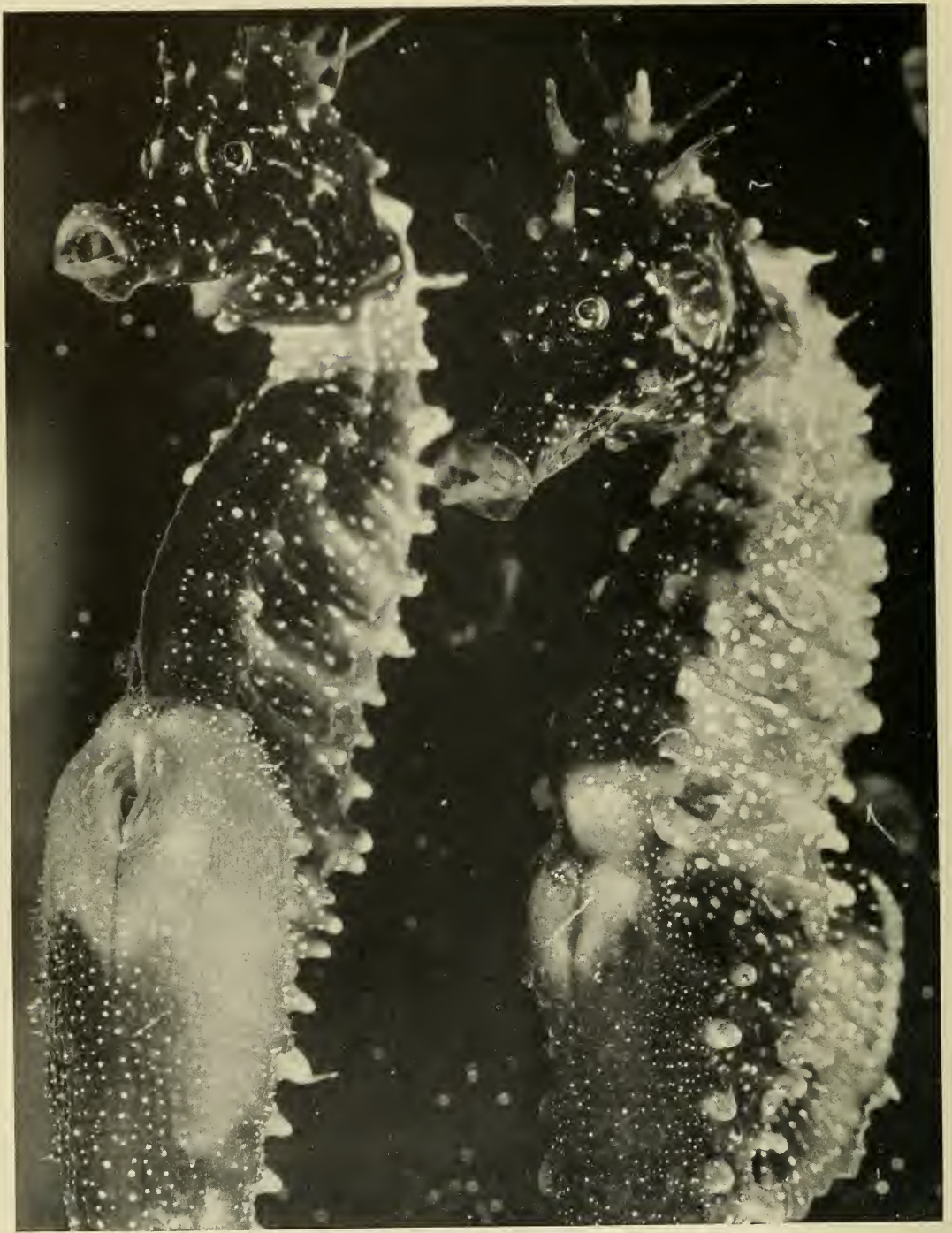


The Curious Life Habits of the Sea Horse

ALL THE ILLUSTRATIONS IN THIS SERIES ARE FROM THE FILM BY JEAN PAINLEVÉ

The sea horse does not swim about much, but spends considerable time remaining motionless, attached to some marine plant by his prehensile

tail. He maintains a vertical position by means of the pectoral fins, one of which can be seen just behind the gills in the photograph above



MALE SEA HORSES

In this photograph of two male sea horses the observer can plainly see the incubation pouch into which the female deposits her eggs by means of her cloacal appendix

The picture below shows very clearly the peculiar shape of the head, the spiral of the tail, the covering of the body, the dorsal fin (the only active fin), and the cloacal appendix with which the female puts the eggs into the male pouch





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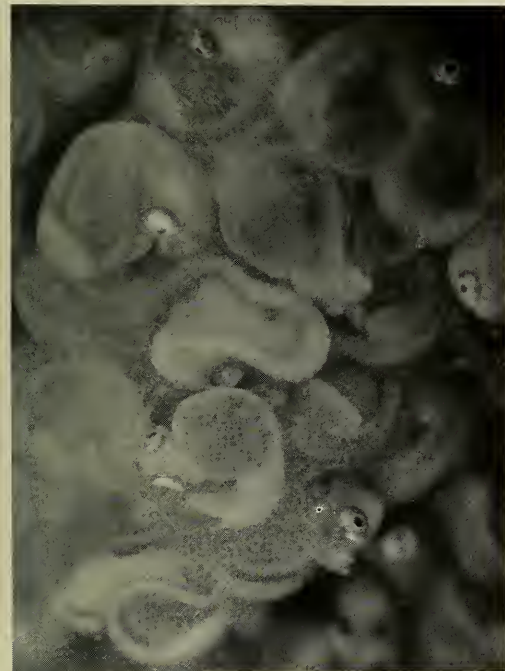
In the European climate the couples begin to unite in the spring. The female carries about 200 eggs. These she deposits into the male pouch by means of her cloacal appendix. The

time for the transfer of the eggs varies from twenty-four to forty-eight hours. Thenceforth the father takes on the duties of the mother and it is his task to bring forth the young



(Above) The incubation pouch of the male in this picture is distended with its burden of eggs. From forty to fifty days are required for the eggs to develop to maturity and the young to be born

(Below) A greatly magnified view of the embryos embedded in the tissue of the incubation pouch of the male



(Below) Detail of the incubation pouch, charged with eggs which will mature during the period of the "male pregnancy"

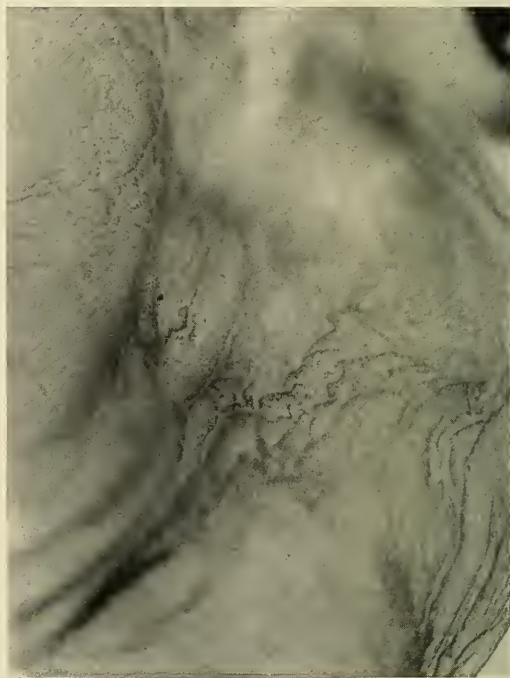




(Above) The male sea horse, at the time of the expulsion or birth of the young, suffers great difficulty in accomplishing this. The pouch is inflated to its limit; finally, with considerable force, the male ejects its burden of young sea horses

(Below, left) Showing the pouch open, giving a view of the embryos embedded in the tissues

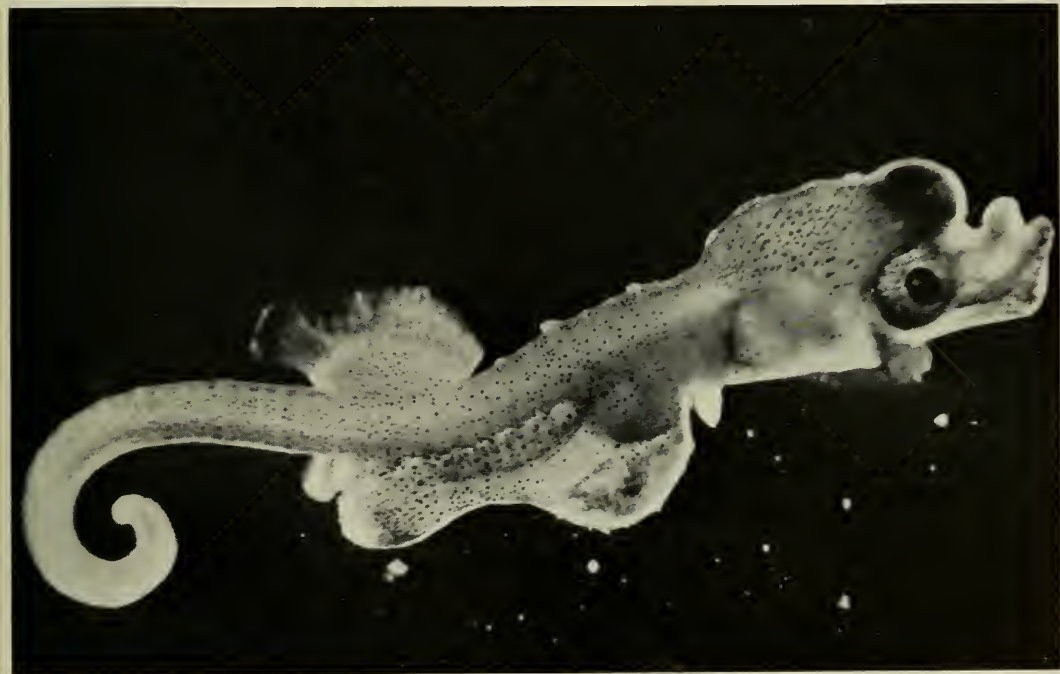
(Below, right) After the expulsion of the young, the inside tissue of the pouch returns to its normal condition





(Above) At this period in the development of the embryo it is still in the pouch of the male. Sometimes, however, it is born prematurely at this time and must overcome many handicaps in the struggle for existence, for it still carries the burden of its vitelline sac

(Below) A young sea horse just after its birth. The yolk is absorbed and the tail already curved, but it still maintains a horizontal position. Note the short flattened snout; also the large eyes reminiscent of those of the embryo still in the egg



When the young sea horse grows up, the spots of pigmentation enlarge, become more regular, and begin to look like stars, as may be seen in the photograph at the right. In the adult stage they finally cover the whole body



(Above) One week after birth the snout is already prolonged, the color thicker and more evenly distributed, and the head begins to form an angle with the body. The animal still swims horizontally, however



(Left) The young sea horse has now arrived at that point in its development when it can swim in the vertical position

A Visit With Grey Owl

In the forests of Saskatchewan, abode of moose, bear, beaver, and all sorts of other wild creatures, where Grey Owl, the conservationist, lives among the animals he befriends

By T. D. A. COCKERELL

*University of Colorado,
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SASKATCHEWAN, so far as I was concerned, was little more than a large blank space on the map. I knew no one living there, nor anyone who had come from there. Our people in Colorado, when they travel, go East or West, sometimes South, but rarely North. When I laid out my route to the local passenger agent, he protested, "Why," said he, "no one ever goes that way." But go we did, my wife and I, and we discovered what was to us a new world.

The southern half of Saskatchewan, the part seen by those who cross the continent in Canada, is a land of rolling prairies, open country where they grow vast amounts of wheat. There are some large lakes, but the general aspect is monotonous. Biologically, this region belongs to the Transition Zone, like the foothill country of Colorado. On the other hand, northern Saskatchewan is a country of innumerable lakes, large and small, and where not under water is covered by forest. It is the abode of moose and bear, beavers and all sorts of wild creatures. In the closing paragraph of his new book, *Sajo and Her Beaver People*, Grey Owl thus describes it:

And perhaps, too, you may hear, if you sit very quietly and still, the rustle of falling leaves, hear the magic call of Talking Waters, and the soft low sound of voices, the voices of the Forest People, both large and small, who dwell in that great, lone land that is so far away, that is so wild, and yet so very beautiful—the Land of the North-West Wind.

It is difficult to exaggerate the beauty and romance of this northern country. It recalls the stories of Fenimore Cooper, of lake and forest,

and travel by canoe. One imagines that the conditions and the life he described were of the past, of a hundred years ago, but here they exist in the present, hardly modified by the hand of man.

It is possible to take a light canoe, which can be carried over the mostly short portages, and go on and on, through the Canadian Zone, into the Hudsonian, and eventually to the Arctic. In the winter, it is extremely cold, and the lakes are covered with thick ice; but in the summer it is warm, the country is gay with flowers, and people swim in Lake Waskesiu. Actually, the latitude is only that of the north of England, but conditions are more boreal, the northern lights are brilliant at night, and the fauna is largely what we call circumpolar, that is, found all round the world in the far north. Thus, of thirteen species of spiders collected at Waskesiu, no less than seven are also found in Europe.

A journey with a purpose

We went to Saskatchewan to see Grey Owl and Anahareo. About two years ago my wife obtained one of the moving picture films, put out by the Canadian Parks Administration, showing Grey Owl and his beavers. This was shown to many thousands of people, in Colorado, California, and Wyoming, and was very popular. Later, the Canadian Parks Department sent us several other films dealing with the same general subject, and in the meanwhile, Grey Owl's books were published, and greatly stimulated our interest in his personality.

Grey Owl had a Scotch father and an Indian mother. He was adopted by the Ojib-

way Indians, to whom he owes his name Grey Owl, given because of his habit of traveling about at night. As a trapper, guide and packer, he was unknown to the public; and we might never have heard of him but for the fact that he and his wife adopted two little beavers which had lost their parents. In the autobiographical work *Pilgrims of the Wild*, Grey Owl tells the whole story. The personality of the young beavers, named McGinnis and McGinty, took hold of his imagination, and he came to feel that the beavers should be protected and not destroyed. The beaver is the Canadian National animal, and it is only too easy to detect its presence in any stream, so that it seemed only a matter of a few years until there would be no beavers in the whole country. Grey Owl and Anahareo became what we should call conservationists, and unwittingly allied to that large company of people, all over the world, who are striving, with remarkable success, to save the native animals and plants.

The power of the press

Even so, what they had to say on the subject, a voice crying in the wilderness, might have had no appreciable effect, had not Grey Owl taken to writing. It is a nice problem for the professors of English literature to explain how he did it. No genius can really explain the fire within him, but it is very interesting to read Grey Owl's account—how he began by writing scraps of stories, things he had experienced or known of, during the long winter evenings, when there was so much leisure time. He did it to satisfy himself, with no thought of a public. With Anahareo, he collected interesting words, and studied their meaning. He read everything which might aid him. Eventually, having accumulated quite a pile of these writings, it occurred to him that he would make a connected story, with illustrations. This he sent to an English magazine.

"I copied the effusion all out laboriously, parcelled it up with about fifty photographs intended to be used as illustrations, and made a special trip to town with it, a matter of forty miles. I was not particularly anxious to sell it, but wanted a whole lot of people to read this stuff, and if they paid me, so much the better."

He remarks that such a thing as a rejection

slip was quite beyond his knowledge, and so when he thought the necessary time had elapsed, he again went to the town, expecting to get his check—and there it was.

Other writings followed, and the attention of the Canadian Park Service was called to the matter. A representative went to see whether the stories about the beavers were fact or fiction, and was more than satisfied. This led to the production of the moving pictures, which were shown far and wide. From East to West they became widely known, and they were a regular part of the entertainment on the Canadian Pacific liners going to the Orient. But curiously enough, they were not known in Saskatoon, the capital of Saskatchewan, and we had the pleasure of introducing them to audiences there. At Prince Albert this was not possible, because no projector was available, and Grey Owl himself had not seen more than one of them.

The Parks Department, through Mr. J. C. Campbell, became so much interested that they appointed Grey Owl as resident naturalist, first in Riding Mountain Park in Manitoba, later transferring him to Prince Albert Park in Saskatchewan. Having shown Grey Owl on the screen innumerable times, we thought it would be very interesting and worth while to see him in his environment, and so have a more vital sense of his personality and his work. Our journey was made in September, which we are told is the most favorable time, though it is after the end of the regular tourist season. The locality is almost nine hundred miles due north of Boulder, but it is not possible to take a direct route on the train. We had to go through Wyoming and Montana to Lethbridge and Calgary in Alberta, and thence on the Canadian National Railway to Saskatoon.

Educational progress

The capital of Saskatchewan, Saskatoon, is a large and attractive town, with a river flowing through its midst, and an excellent University. There is now a large school system, with over 350 teachers, but so recent are all these developments, that we were told that at the beginning of the century they had only a single teacher. Much scientific work is done at the University, and there is an important forestry department, which supplies innumer-

able small trees to be planted as wind breaks in the open country to the south.

From Saskatoon we took the train northward to Prince Albert, where we met Major J. O. Wood, the superintendent of the Park. From this point onward, we were indebted to him for our transportation and all the facilities, without which it would have been very difficult to proceed. There is now a good automobile road to Waskesiu, a village on Waskesiu Lake, the center of all the activities in the Park.

In Grey Owl's homeland

At this point we were transferred to a canoe, with a motor attached to the stern, and thus traveled the whole length of the lake, some fifteen miles. There, after a short portage, we crossed Kingsmere Lake, a matter of about six miles. At the north end of Kingsmere is a warden's lodge, and another portage leads to the small Ajawaan Lake, where Grey Owl has his cabin. On the way we met Grey Owl and Anahareo, who had come out to meet us.

Those who have seen the beaver films will have a good idea of the place. The little log cabin, mirrored in the lake, is known to many thousands. The lake itself, with numerous water-lilies, and surrounded by dense forest, mainly coniferous trees and aspens, is very beautiful. It is quite unspoiled, and far enough away from Waskesiu to be beyond the range of the ordinary summer tourists.

We spent the night in Anahareo's cabin, up on the slope of the lake. We saw the famous beavers, Jelly Roll and Rawhide, and saw them do some of the things we had shown so often in the pictures. They came from the Province of Quebec, and Grey Owl has had them for about seven years; he thinks that the life of a beaver is probably not less than a quarter of a century. Their young, born each year, normally wander away to seek mates and found new colonies; but recently one came back with a mate, and is building a lodge close to Grey Owl's cabin, being helped in the work by the old beavers.

We had a delightful evening talking and telling stories, and discussing the prospects of Grey Owl's lecturing tour in England, for which he was getting ready. He sailed on the "Empress of Britain" from Quebec on October

12th. At night, Grey Owl spends some time patrolling the forest near the cabin, and I was allowed to accompany him. But he said that the animals would be alarmed to hear a strange voice, and he frequently called "All right," in a characteristic way; not that they would understand the words, but they would instantly recognize the familiar sound, and know that their protector was there. A large moose had been in the immediate vicinity for some time, and we saw him in the wood, a vaguely outlined form in the dark, with an eye brilliantly deflecting the light of Grey Owl's flash light. We did not venture to go very near, for it was the season when moose are apt to be dangerous.

The next day we saw part of the new picture, to be taken to England, being filmed, and then started on the homeward journey. I now quote from a letter I wrote to Grey Owl from Waskesiu, describing our adventures after leaving him.

"We ventured forth on the wobbly waters of Kingsmere, and all went well for a time, but the waves rose higher and showed white caps, and the spray came into the boat, and presently the water ran down my wife's back and wetted our coats, and was very cold and uncomfortable. So we put ashore at a place where there was a deserted fisherman's house, and built a fire, and got dried out, and the canoe went round a perilous point, while we took the trail across the forest, a beautiful path among the trees, with red leaves and toadstools of all colors on the ground. We came out eventually and again took the canoe, and this time arrived without difficulty at the portage.

A water-logged canoe

"Reaching the Waskesiu Lake side—there was the canoe of the day before, but it had been exposed to all the rain, and was as wet as canoes can be, and the motor was somehow water-logged. The boys worked and worked, and it really seemed that we should never get away, and all the time it was getting darker and colder. But at last the motor recovered its strength, and off we went. I think it was 7:15.

"It was soon night, but although it was cloudy, the moon kept us sufficiently lighted to see the way. We hurried along through the narrow part of Waskesiu Lake, and the water

was calm, and everything just as it should be. But as soon as we came to the beginning of the broad part of the lake, the motor ceased to function, having (as appeared later) got flooded with water. After numerous efforts it was decided that there was nothing left to do but to go ashore, so we landed on a little sandy beach, in a small cove.

The "Hotel Cockerell"

"We think of asking the park authorities to name this place the Hotel Cockerell, for such it was for us. There is a good sandy beach, but just back of this only trees and dense brush. The only place we could have a fire was on the beach, although the wind was now blowing in-shore and was cold enough. But we had blankets, and curled up, making ourselves as comfortable as circumstances permitted. This all happened at 9 p. m. It was quiet, except for the wind, and no creatures came around. At one time I suddenly thought some insect was biting my nose, but it was only a spark from the fire.

" . . . By 4:30 some evidence of the coming morning was apparent, and a duck scuttled over the water, and presently some loons flew overhead. The pinky dawn came slowly, and it was now possible to doctor the sick motor, and we got away at about six o'clock. On the sandy shore I found a good lot of fresh water shells . . . We made the journey across the wide part of the lake in something over an hour (the motor losing heart every now and then) and got to the Pleasant Inn at Waskesiu just as they were opening up, and a good Chinaman gave us an excellent breakfast."

We had only been a little while in Grey

Owl's cabin, when he produced his new book, copies having been received from the publisher two days before. It is *Sajo and Her Beaver People*, a most charming story for young and old, about two Indian children and their pet beavers. On the title-page Grey Owl wrote "In remembrance of a pleasant and long-looked-for visit, with kindest regards to Mrs. Cockerell, from the Grey Owls." The style and character of the book are quite unique, but if comparisons must be made, we think first of Hans Christian Andersen.

On our way homeward we stopped again at Prince Albert, and there saw Dawn, the little daughter of Grey Owl and Anahareo, now three years old. She is a very lively and dramatic little person, reminding us especially of her mother.

Autumn beauty

Since we got home, a letter from Grey Owl, dated September 23, describes "this, the loveliest time of the year, though the Park may be officially closed. This place is very, very beautiful now, and all the leaves are turned, and the forest is a golden hall of dreams and beautiful thoughts. The beavers are working steadily, and you just must be here to see it. It seems so selfish to enjoy this all alone, the two of us."

As to the purely scientific results of the journey, it is too early to say much. But as always happens, new vistas were opened up, and all sorts of interesting problems presented themselves for solution.

We are indebted to Mr. J. C. Campbell, of the Canadian National Parks, for most of the illustrations used on the following pages.



Canadian National Parks Photograph

The sandy shore of Waskesui Lake in Saskatchewan. The untouched beauty of

this land recalls the settings of Fenimore Cooper's stories

A Visit With Grey Owl

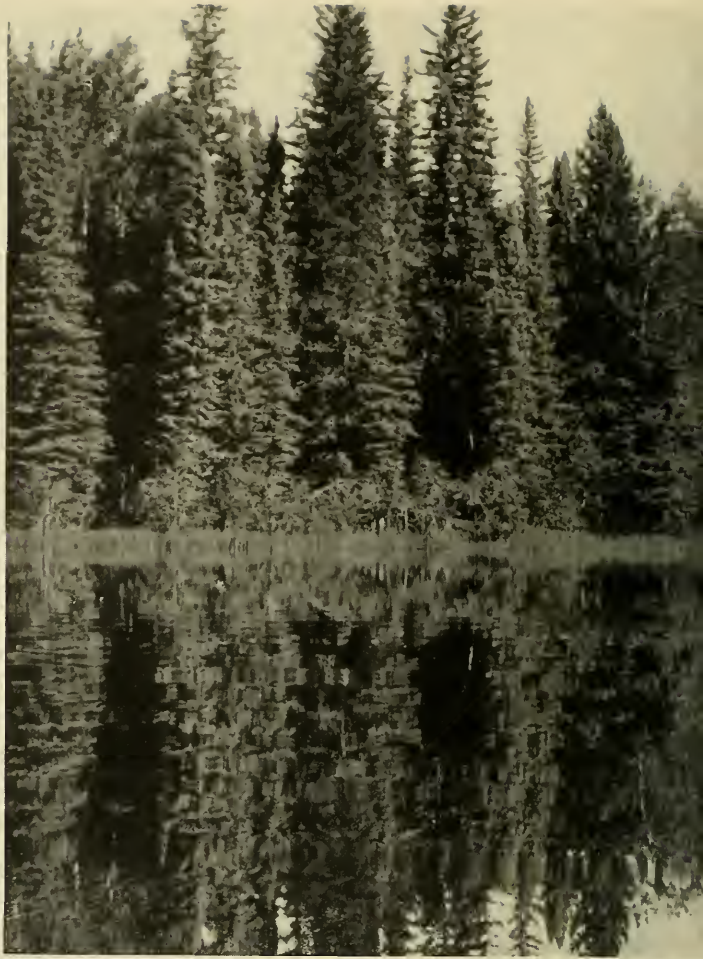
Photograph by W. J. Oliver

Grey Owl and Anahareo with Mr. and Mrs. Cockerell at the warden's lodge on Kingsmere Lake



*(Right) "Beaver Lodge,"
Grey Owl's cabin, on the
shore of Ajawaan Lake. The
little log cabin lies in the
midst of a beautiful forest
which harbors interesting
wild life in its denseness. A
little to the left of the cabin
the Cockerells spied a moose*

*Canadian National Parks
Photograph*



*(Below) Grey Owl feeding
a beaver. The survival of
these animals in Canadian
National Parks is largely due
to the energetic conservation
work of Grey Owl*

*Canadian National Parks
Photograph*





(Below) A food raft made of aspens by the beavers, which Grey Owl considers one of the largest and best he has ever seen. It is easy to detect the presence of beaver

*Canadian National Parks
Photograph*





(Above) Grey Owl and a Canada jay. These birds are very tame and are well known to campers in the woods. Those in Prince Albert Park are the typical Canada jay, different from the Rocky

Mountain race. Canadian National Parks Photograph.

(Below) Mr. Cockerell is drawing pictures to amuse Dawn, the three-year-old daughter of Grey Owl and Onahareo

Photograph by Mrs. H. S. Winters



A Dragon Fly Emerges

PHOTOGRAPHS BY CROY, FROM BLACK STAR

The dragon fly or darning needle as we commonly know it is the insect which perhaps most reminds us of an airplane. Poised delicately on a water plant, its four large wings remain outstretched, while in flight they carry it rapidly above the surface of the water or over fields in search of small insects upon which it feeds. But before the dragon fly becomes a flying insect, it lives under water in a quite different form

1. The upper figure in this photograph is the dragon fly larva among weeds in the water immediately after shedding its skin, which is seen below





3. (Below) Presently the upper portion of the body is free; but part of the wing pads, from which the gauzy full-grown wings will develop, and most of the body are still encased in the skin

2. (Above) When the inner development of the dragon fly is finished, the larva crawls out of the water, and the wonderful transformation takes place. The back bursts open and the dragon fly begins its emergence by thrusting out the back of its thorax



4. (Below) The insect continues to slip farther out of the skin. Even the legs must be drawn from individual sheaths like fingers from a glove. It now bends backward until the claws on the legs can grasp the plant



5. (Above) The dragon fly has completely emerged. The body is still soft and flexible. The wing pads are thick and opaque and must be expanded by having blood and air pumped through the many veins



6. (Above) The wings are now fully expanded but their milky color attests to their softness. As yet the adult dragon fly is quite helpless; the body is equally soft



7. (Below) The dragon fly has now reached the perfect stage, but it is not yet ready to fly. Though the wings are shiny and transparent, they are yet too soft for locomotion



8. READY FOR THE FIRST FLIGHT

The dragon fly has extended its wings and in a moment will take to the air for the first time. Never again will it rest with wings folded over the back. It will pass the remainder of its existence skimming over water, marshes, and hillsides, preying upon other flying insects.

It will lay its eggs in the water where they will soon hatch into tiny nymphs that will look exactly like the one that crawled from the water at the beginning of this series of photographs. The transformation generally requires only about an hour or less from the time when the creature emerges until it flies

A Mineralogist Abroad

How the traveler willing to leave the beaten track can visit many fascinating mines and quarries, and build up his own collection of semiprecious stones and minerals

By FREDERICK H. POUGH

*Assistant Curator,
Minerals and Gems, American Museum*

ONE goes to Europe to see art museums, to study architecture, to hear music, or just to get away from it all; but, unless one is peculiar that way, one seldom goes to "do" Europe mineralogically. However, for those who fall in the latter group, there is a great attraction in a trip through Central Europe, especially Germany. It is there that mineralogy got its start as an independent science, and there that many of the world famous mineral localities are, or were.

The explanation of the rarity of mineralogical visits lies in the last word, for today many of the old mines of Schneeberg and Johanngeorgenstadt, famous in their own right for their productivity and made better known by their literary and historical associations, are hardly to be found. Of many, even the dump has disappeared; hauled away to be used in roads or so overgrown that it looks like little more than a natural mound.

Some mines are still in operation, however, and new ventures have been started at old localities. In addition, fine collections may be inspected, unparalleled specimens seen, and some of the older mineralogists may be met and talked with. There is so surprisingly much to be seen and found on such a trip that it well repays the effort.

Transportation difficulties

Traveling through Germany in a leisurely fashion and collecting minerals at more or less

remote localities involves certain transportation difficulties. The happiest solution to the problem seemed to be the bicycle, a universally used vehicle in Germany. The practicality of the bicycle was proved at the first locality visited, the strontianite occurrence at Drensteinfurt near Münster in Westphalia, for the owners of the mine simply mounted upon their bicycles and all rode companionably out to the mines.

Old hunting grounds

These were formerly very active, but few are now in operation. One of the most famous, the Grube Mathilda, is marked only by a dump today, the Anna Mine, next in line along the same vein, closed down this summer to give way to the Eleonor Mine, still farther along the vein. The vein continues for a long distance across the country, cutting across the nearly horizontal sedimentary formations and widening out at intervals into lens-like pockets, on which the different mines are situated. It was discovered and traced by borings, no outcrops showing on the flat topography of the region.

Each owner has named the mine for his wife; and as the mines outlasted the wives and the owners, no complications over names have so far ensued. Good crystals of strontianite are still to be found, small and colorless or larger and white, attached to matrices of calcite or fibrous strontianite. The present demand for strontium is slight and much of the production is probably used in the manufacture of fire-

works for the castle illuminations at Heidelberg, Würzburg, and along the Rhine. It was formerly used in greater quantities in the manufacture of sugar, but other processes have largely superseded the strontium hydroxide separation method.

The route south of Münster, through the Ruhr valley, leads to Cologne, with its magnificent cathedral. The cathedral has mineralogical as well as æsthetic appeal, for Krantz, the famous mineral dealer in Bonn, admits that his source of the well-known Drachenfels sandine porphyry is not that castle-crowned peak,

but the Cologne cathedral. Its periodic partial renovations release somewhat weathered blocks which are more easily broken to reveal the crystals in the finer matrix. The original source, near Bonn, is a popular climb for visitors to that city. Near the summit, along the main path, vertical cliffs mark an old quarry face, at the foot of which loose blocks are abundant and good specimens easily collected, though not without the attentions of a gathering of curious people and donkeys. Crystals showing several habits and different types of twinning may be found. As the tabular crys-



MINERALOGICAL HIGH SPOTS

The region visited by Doctor Pough, showing the most famous mineral localities of Germany

and Austria. A serpentine trip of 2200 miles made on a bicycle

tals have a tendency toward orientation in parallel planes, it is necessary to find the proper plane and break the block to develop maximum surfaces in this plane.

Bonn itself has a fine mineralogical institute and its former head, Prof. R. Brauns, though retired, is still active and is probably the best known of living German mineralogists. The collections contain many specimens of minerals from the Eifel, a volcanic region lying to the west of the famous scenic stretch of the Rhine.

Beautiful conical peaks and crater lakes with frequent lava flows are scattered over the landscape, showing by their perfection of form that they have not long been extinct. Quarries are numerous, for the lava is made to serve many purposes. Chief among them is the manufacture of road blocks, so popular as a paving material in Germany. Skillful workers chip curbs and millstones out of the material, without the aid of any machines. The columnar basalt prevailing in several quarries is very simply put to use without even the necessity of shaping the blocks. They are white-washed and erected along the roads to serve as guards and markers. Piles of these columns, looking for all the world like cordwood, may be seen along the Rhine, near Remagen.

A famous mineral region

The region is famous mineralogically, partly for the crystals of such minerals as zircon, apatite, and hauynite found during the quarrying operations, and still more for the rarer minerals occurring in the sanidine blocks that were thrown out of the volcanic vents during eruptions. Collecting over this terrain is fascinating, with always the chance of discovering a good specimen. Fresh blocks are uncovered by every storm and every plowing so the field is perpetually rejuvenated, and actively working quarries are always productive collecting sites. Fall, after the potato harvest, is the best time for search, offering the largest number of freshly exposed blocks with peaceful working conditions. At other times the farmers are less enthusiastic about people strolling through their fields.

A little south of the Eifel lies Idar, the home of the German gem industry, where all phases of the trade may be seen and wonderful stores of raw material examined. Still farther

south is Heidelberg, the seat of the oldest German university, on the edge of the Odenwald, where the Neckar enters the Rhine graben. Heidelberg is famous in the history of geology and mineralogy, for Rosenbusch and Goldschmidt, two of the masters of the science, worked here and many of the best known American geologists studied here under their guidance. The famous Seligman collection of minerals, one of the finest private collections in Europe, is now in Heidelberg, the property of Gehr. Bosch, of the German Dye Trust. The Victor Goldschmidt Institut für Kristallforschung, carrying on the work of its former head, and the Rosenbusch petrographic collection are also in Heidelberg. *Homo heidelbergensis*, another old resident, is still to be seen, investigations into his ancestry having revealed no reason for his banishment from the place of honor in the university.

Fluorite mines

Though formerly the site of much mining, southwestern Germany produces little of interest today, and one must go eastward nearly to the Czechoslovakian border before mineralogical interest is again aroused. The limonitic iron ore mines near Amberg occasionally yield interesting phosphate minerals. Far overshadowing these in interest, however, are the famous fluorite mines of the Wölsenberg.

Wölsendorf, the nearest village, will not be found on any but the most detailed of maps, for it contains but a few houses, and no road, just a winding path, leads to it. The approach along a road from Schwandorf leads across a bridge, where a sign marked Wölsendorf indicates a trail, but the path soon divides into several forks each leading to a different cluster of houses off against the hills. One must be psychic to select the right group from this lot, but eventually, by making enough inquiries, it can be found. The several mines, of which two are in operation, lie behind the town at the edge of the hill. With luck interesting specimens can be collected, showing crystals of fluorite or nice banding reminiscent of the famous English "blue-john." The fluorite is used for the manufacture of acid and in the aluminum and steel industries.

The most interesting minerals of the deposit (and they are only to be found at the Johan-

nisschacht) are the associated uranium minerals occurring in masses of the dark fluorite, which emit a strong odor upon fracture. This type of fluorite is known by the appropriate name of "*Stinkspath*"; the smell is said to be that of free fluorine and resembles an exploded firecracker more nearly than anything else in common experience.

The rare uranium minerals are found in cavities in this material, and the beautiful yellow needles of uranotile are well known to collectors. Somewhat rarer are the square platy crystals of uranocircite, of a yellow-green color varying according to the light source. An intense fluorescence is responsible for the green tones and is very noticeable in ordinary sunlight. Many of the Belgian Congo uranium minerals have been found in small quantities at this deposit; and pitchblende, the original uranium mineral, may occasionally be found. Quartz druses, earlier than the secondary uranium minerals and brilliant red in color, with yellow barite crystals are common.

Unique phosphate pegmatite dikes

Not far north are the unique phosphate pegmatite dikes of Pleystein and Hagendorf. At Pleystein is the Kreuzberg, an isolated abrupt peak in the middle of the town, about two hundred feet high and not more than a quarter of a mile across. The nearly vertical walls are composed of white quartz, and at their top is a monastery, giving the hill its name. The quartz is a pegmatite outcrop and for a time was actively quarried for road material. During this activity the rare minerals kreuzbergite, phosphosiderite, strengite, kraurite, and so on, were found, but as the work endangered the buildings above, operations were halted and the entire hill is under *Naturschutz*. A fine little collection of the minerals of the vicinity, made up by a resident of Pleystein, may be seen in a small museum maintained by the town.

Hagendorf is near by and is the most famous of the pegmatite regions. Here there are two mines, producing feldspar, but only one was in operation during the summer, and that, mineralogically is the less interesting. Apatite and other phosphates are sometimes found in this dike, but the knots of mica in which the cavities containing the beautiful crystals of

phosphophyllite, vivianite, wentzelite, fairfieldite and other minerals are found, are restricted to the border zones of the other pegmatite. After the manager is convinced that the visitor is not a Czech who wishes to spy, there is no trouble about inspecting the plant or collecting on the dump.

Not far north, on the borders of the Erzgebirge, the greatest mining center in Germany, is another fluorite deposit of a unique character and of interest for the fluorite itself. This is at Schönbrunn, by Oelsnitz and not far from Plauen. The deposit consists of two nearly vertical, banded veins showing successive layers of fluorite in crusts of octahedral crystals, alternating with bands of feldspar and quartz. At the center is a later fluorite in larger masses in cubic crystals. Late hydrothermal action has altered and decomposed the feldspar, so that it is not difficult to secure good specimens of the octahedral crystals by splitting the specimen at the contact of the fluorite with a later layer of feldspar. Sometimes deep purple octahedrons are found perched upon the apices of larger green octahedrons; curved octahedrons, nearly spherical in form, and dodecahedrons are known. Crystals of this earliest generation never occur in vugs, the few vugs that are found appear to have been later in their formation and to have been largely filled by a late generation of secondary fluorite in small cubic crystals. Associated with this late phase are sulphide minerals and beautiful iridescent crystals of goethite.

Topaz crystals

From here it is not far to Schneckenstein, one of the most famous of the old localities. Schneckenstein means "snail-stone" and refers to the original shape of a mass of rock projecting above the ridge upon which it stands as an erosional remnant. Schneckenstein was described and pictured in one of the oldest mineralogical works and looks today much as it did then. For a number of years the rock was actively quarried for the topaz found in it. Numerous stones cut from this topaz may be seen among the Saxon crown jewels in the Grüne Gewölbe, in Dresden.

The remnants of the old workings and a large dump may still be seen with topaz crys-

tals everywhere abundant. Signs proclaim it under *Naturschutz* and prohibit all collecting, as they prohibit everything else in Germany, but for once their message is not heeded, and nearly always someone is sitting on the dump and pounding away at the fragments, seeking topaz for collections or for cutting purposes. The present abundance of topaz, despite several centuries of such collecting, proves that it was not rare here, although good cuttable crystals are not common. Finding good specimens, as is often the case, is merely a matter of hard work and a little luck. Topaz is by no means restricted to this rock mass, it is to be found in a narrow zone several miles long which has been subjected to a topazing alteration, and the result seems to have depended upon the nature. A breccia, with many vugs filled partly or completely by crystals of quartz, topaz, columbite, wavellite, and other minerals has been formed at Schneckenstein. A little to the north of the Schneckenstein is an outcrop of a porphyry, in which the feldspar has been altered to topaz and the ground mass to a sugary mass of quartz.

Old specimens at Schneeberg

Schneeberg, lying in the heart of the Erzgebirge, was once the source of the most beautifully crystallized specimens of some of the secondary cobalt minerals and other rare minerals. Today there is but little mining there, mostly of bismuth for pharmaceutical preparations, but one may visit the offices of the company, and after a little persuasion, view the old specimens. Incomparable crystals of erythrite, roselite, sphaerocobaltite, troegerite, walpurgite, zeunerite, and so on in numerous examples may be seen. The best specimens were found between 1870 and 1900; since then little worthwhile has appeared. The employees still wear the old garb indicative of their position as white collar mine workers; a short black jacket with much fringe and some gold decorations, with buttons marked by the crossed hammers, the emblem of mining throughout Germany.

Johanngeorgenstadt, a few miles away, with its mines now under the same direction, is another famous old mining town, with but one mine, the Wildman, still in operation. On the plain a little above and behind the town, is the

"*Pferdegöpel*" a mine more than two hundred years old, which was running until twenty-five years ago. The power was supplied by a team of horses which walked around a circular track within a conical building, turning a drum which raised or lowered the skips in an inclined shaft 67 *Lachten* deep, a *Lacht* being about six feet. The buildings are said to be the only ones of the type preserved in Germany today. Johanngeorgenstadt is now the center of glove manufacture and most foreign visitors today are the glove buyers. A tablet in the hotel commemorates Goethe's visit to the mines, with a quotation from a letter written there describing his awe and wonder at the subterranean world.

Silver "thalers"

St. Joachimsthal, or Jáchymov as it is now called, is just over the border in Czechoslovakia and is best known as a bath resort purporting to cure nearly anything with its potent radium waters. Radium is actually mined in the town in the form of pitchblende or uraninite, and this is the source of all the radium sold by the Czechoslovakian government. The earliest mining operations were for silver, and during the fifteenth and sixteenth centuries more than 1,200 men were employed, working the rich proustite, pyrrargyrite, and native silver deposits. Silver was so abundant that a mint was established in 1518, and coins known by an abbreviation of the name simply as "Thalers" were made. Because of the purity of the silver they were in great demand, and the name widely known. After going through several transformations it has emerged to give us our name for our unit of coin, dollar, the word having been derived from the old name for these coins.

As the mines deepened, the silver began to diminish and they were operated more for their bismuth, cobalt, and nickel ores. Uraninite was known but thrown away until 1852, when it was discovered that good pigments could be made from it. Ever since, this has been primarily a uranium mine. The secondary uranium minerals found in recent years in the mine are the result of reactions between the pitchblende and the products of oxidation of marcasite with which it is sometimes in contact. As the oxidation can only take place

after exposure to the air through the mining operations, uraninite is the only uranium mineral occurring altogether naturally in the mine.

Above Jáchymov, extending to the border of Germany, is a high, bare, rolling mountain region which is a popular winter resort, and ski-school after ski-school dot the landscape. It is a barren, bleak land, giving an impression of being much higher than it is, and must be wonderful skiing country.

From there the famous tin and tungsten mines of Ehrenfriedersdorf are not far, but the purple apatite which abounds in many collections comes, not from the mines, but from a comparatively small granite quarry on a hill known as the Greifenstein, above the town. On the summit are a series of granite needles, forming prominent pinnacles which serve as a background for a *Festspiel*. The granite quarry is in the woods, not far from the summit, and the stone is quarried for roads and building purposes.

Luck and patience

A narrow vein, not over four inches wide in most places, cuts through the granite in one corner of the quarry, and from this single vein all the apatite specimens have come. It appears to be richest in apatite where the vein is thinnest and the quartz at a minimum, with crystals of both minerals attached to granitic matrix. As the vein widens and the quartz increases, the apatite disappears, fluorite or torbernite in rare crystals occurring in its stead. Without luck, nothing will be found, as the workers collect the good specimens to sell as soon as they are revealed, but by digging around in the dirt which has been washed down at the side of the quarry where the vein disappears into the granite, it is possible to find quite nice specimens.

Across the road in the woods adjoining this quarry, is a small prospect pit, in which was uncovered a quartz vein with embedded colorless to pale blue crystals, about half an inch long, of brilliant, well-terminated topaz. The most difficult part is locating the pit; once found, specimens are easily collected.

Mecca, for the mineralogist, is Freiberg in Saxony, for it was here that Abraham Gottlob Werner, credited with being the founder of the science of mineralogy, taught, as a pro-

fessor in the world-famed mining academy. The *Bergakademie* has a fine new building now, but the mines of Freiberg are a thing of the past, and except for the historical interest of the town and collections on display, there is little to be seen. The collections are well worth a visit, however, for the specimens of crystallized Freiberg ore minerals are unequalled elsewhere. Freiberg still lives in its past and one sees many relics of the heyday of its mines. The crossed hammer insignia are everywhere, figurines of miners in their traditional uniforms, with their leather knee pads and leather aprons worn behind instead of before, are to be seen in many shop windows. A search may even reveal miners' *Batten*, axe-like implements formerly used as weapons or tools, old miners' tallow lamps, or even an ancient copy of *Agricola*.

To the east of Freiberg lies Dresden, one of the most fascinating cities in Germany and the capital of Saxony. In one of the former palaces, the Zwinger, is a small collection of minerals. The Grüne Gewölbe contains the crown jewels, including the famous Dresden green diamond, and a collection of worked objects; precious stones, carved crystal, amber and ivory. An interesting pair of figurines in bronze portrays two negro boys bearing rich emerald specimens from the mines of Columbia, but to which, alas, the best crystals have been attached by man and not by nature.

Through Czechoslovakia

South of Dresden the route lies through the crest of the Erzgebirge, past the former tin mines of Zinnwald, threads between the volcanic peaks of northern Czechoslovakia, source of beautiful zeolite specimens in the collection of the American Museum, and out on to a plain which extends all the way to Prague. In the immediate vicinity of Prague there is little of mineralogical interest, but the museum has a fine collection, well displayed in stepped cases. The Czechoslovakian university has a well-equipped mineralogical institute with Prof. Slavik at its head; there is a German university as well but it seems to be less prosperous.

A big jump from here takes us into the Tyrol; across glacial outwash plains, up terraced valleys, into the very heart of the moun-

tains. The region known as the Salzkammergut is scenically superb and receives its name from the many salt deposits worked in the area. These salt beds are not horizontal, as are those of northern Germany, but are highly folded and contorted by the forces responsible for the mountain structures.

Unsurpassed scenery

The most interesting portion of the Tyrol, however, is the mountains known as the Hohe Tauern, lying to the south and west of Salzburg. The range is composed of two peaks, the Gross Glockner, up which an automobile road has just been built, and the Gross Venediger. They are large mountains, covered by glaciers and rising over 3,500 meters. Four valleys, running side by side on the northern slope of the Gross Venediger, have produced most of the minerals for which the Tyrol is famous. They are: the Hollersbachtal, the Habachtal, the Untersulzbachtal, and the Obersulzbachtal. Most collections contain specimens recognizable to most collectors on sight as epidote crystals from the Knappenwand of the Untersulzbachtal, a locality which has long since ceased to yield specimens, but which will undoubtedly remain as the most beautiful of all epidote occurrences. The Habachtal is nearly as famous for its emerald mine. It is a wild and rugged region, visited only by climbers. A road of a sort extends halfway up the valley to several climbers' inns; beyond, the floor soon rises above timber line and becomes very rocky. At the end the Habach glacier perches above a cirque and its melt-water flows in a white cascade over the lip, down to the floor a thousand feet below. As a collecting ground for minerals it is scenically unsurpassed, with the white summit of the Gross Venediger looming in the distance.

The region has been carefully studied and its geology is well known. A progressive metamorphism toward the granite core has been noted and the minerals to be expected from each point along the ridges on either side can be predicted. The old emerald mine lies near the uppermost of the inns but about three thousand feet above it, just below the crest of the ridge. The workings may still be seen and bits of the mica schist in which the crystals occur can be collected. As gems the emer-

alds were never of very high quality but this sort of an occurrence of emeralds in metamorphic rocks is unique.

Less well known are the specimens of emerald in a serpentine or talc schist, apparently derived from an alteration of the original mica schist with the emerald surviving, relatively unaffected. There are three dumps, two of which are now pretty thoroughly picked over, while the third, usually covered by a snow bank, is seldom accessible. The mine now belongs to an English company, but probably never will be reopened.

The other specimens for which the Habachtal is famous are those of adularia, quartz, and sphene, which may be found along the entire inner third of the valley. Naturally, after generations of collectors, good specimens are not easy to find, but the occurrence may be seen and specimens showing the associations collected without leaving the main trail up the valley. The country rock is a mica schist, through which quartz veins cut at all angles, widening out or narrowing down with great irregularity. Here and there vugs occur, and in these vugs adularia, calcite and quartz crystals are common, with occasional sphene in brilliant golden yellow transparent crystals.

The higher slopes still abound with good specimens; and the less energetic collector may, with some hope of success, search over the talus on the floor below, for it is being continually renewed by boulders showering down from the cliffs above. But for the "Mohammeds" who insist upon going to the mountains, it would be possible to wait for the mountains to come to Mohammed. However, one does not begrudge the effort, for the possibility of collecting superb specimens, coupled with the magnificent scenery, make it truly a collector's paradise.

The rewards waiting for the traveler who makes such a journey and visits these places are manifold. The many mines that are still in operation, the collections to be seen, the inspiring men to meet, all serve to make such a trip memorable and one worth any inconvenience and difficulty it may involve. The mineralogist sees not only all that the tourist sees, but finds things of intense interest where the ordinary traveler sees nothing, and perceives a deeper significance where the tourist sees only the superficially interesting aspects.



(Above) The castle-crowned peak of Drachenfels. In the circle is

a specimen of sanidine porphyry from the Drachenfels

A Mineralogist Abroad

(Below) Volcanic peaks in the Eifel. Bell lies in the valley between two flows of lava, with typical low conical peaks in the background





(Above) The Palisades of the Hudson in miniature,—a basalt quarry on the Rhine. (Circle) Future road guards piled for shipment

(Below) The Pferdegöpel at Johanngeorgenstadt. The last survivor of horse-powered mine shafts, over 200 years old



UTILIZING NATURE'S PRODUCTS

(Below) Hand-picking the ore in Germany's most interesting but little known fluorite mine, at Schönbrunn near Plauen in Vogtland. In

the circle are some octahedral crystals of fluorite in a matrix of quartz and feldspar from this mine





Miners' lamp of hand-wrought iron used in the sixteenth century in the Erzgebirge. The bright flame emanates from the original wick burning the ancient tallow with which it is soaked. In use the lamp was hung from a timber, or mounted upon a stick fitted into the socket at the back

(Below) The entrance to a drift of the famous Stahlberg mine in Müsen. The crossed hammers, symbol of mining, are the emblem of the Bergakademie in Freiberg





(Upper) The upper Habachtal. The talus slopes and shoulders to the immediate right and left are productive collecting grounds of

the minerals for which the valley is famous. (Lower) Epidote from the Untersulzbachtal, the neighboring valley to the east



(Above) Anabas on land. This amazing fish can travel long distances overland when in quest of new aquatic environment. Drawing by D. M. Blakely



(Left) Anabas in water. It looks like an ordinary fish in this environment, but the fact is, it cannot live without air

A Walking Fish

It drowns if it cannot reach the air, climbs steep banks, walks long distances on dry land, and perhaps even climbs trees

By HUGH M. SMITH
*Formerly Fisheries Adviser to the
Kingdom of Siam*

IN 1791 a Dane named Daldorff, while in Tranquebar, at that time a Danish possession in India, came upon a fish which, during a heavy rainfall, was climbing a Palmyra palm and had reached a point five feet above the ground. There it was apparently enjoying itself in a little stream running in a fissure in the palm's trunk from a broad frond which collected the rain water as in a funnel. Near-by was a swamp from which the fish had probably come.

Daldorff published his observations in the Transactions of the Linnaean Society of London in 1797 and described the fish as a new species under the name of *Perca scandens*, or climbing perch. He was the first European to give an account of the live fish, but the species had already received the name of *testudineus* (in reference to its hard covering like a turtle shell) at the hands of the German zoölogist Bloch in 1795, so the significant name applied by Daldorff had to yield to the law of priority.

Christened anew

The name climbing perch by which the fish has generally come to be known among English speaking people and in English works of reference is somewhat inappropriate. The fish is not a perch and is not even remotely related to the true perches, common fresh-water fishes of America, Europe, and northern Asia. The generic name *Perca* first borne by the fish had no nomenclatorial standing, and in 1817 the fish was brought by Cuvier under the new

generic name *Anabas*, or climber, and became the type of the oriental family Anabantidae, which includes such well known species as the diminutive paradise fish, the Siamese fighting fish, and the giant goramy. All of the members of this family have, in addition to gills, an accessory breathing apparatus, and most of them blow bubbles to form a floating nest in which the eggs remain during incubation.

Alternate common names by which this fish has been called are climbing fish and walking fish, but these are borne also by several gobies, catfishes, serpent-head fishes, etc. On the whole, it may be best to adopt the perfectly distinctive generic name as the common designation of the fish in European languages and call it *Anabas*.

A tough coat

Anabas seldom exceeds eight inches in length and averages about six inches when fully adult. Its blunt head is very hard and the gill covers are bordered with backwardly projecting spines. The body is enclosed in a thick, tough coat covered with hard overlapping scales which are edged with spinules. The dorsal and anal fins contain sharp spiny rays. The thick skin retards the loss of moisture from the tissues when the fish is out of the water, and the spinous armament discourages or altogether prevents the attacks of water and land snakes, water lizards, birds, and other fishes. The small, conical teeth are in bands in each jaw, and are adapted for crushing insects, shrimps, and snails which constitute a large part of the food.

There are gills such as ordinary fishes possess, but the gills in the long process of evolution have become less important and are now quite inadequate to sustain life. This is

easily shown by putting a fish in an aquarium with a wire-mesh screen just below the surface. With inability to take in atmospheric air, the fish begins to suffer and will soon die. The reduced gills represent only a small proportion of the total respiratory surface, and the major part of respiration is carried on by means of a special structure occupying a cavity over the gills and consisting of a series of thin, concentrically arranged bony plates covered by a vascular mucous membrane which enables the fish to absorb atmospheric oxygen.

Some writers have apparently failed to appreciate the exact rôle of the accessory branchial organ in *Anabas*. Thus, Dr. Francis Day, who spent many years in India and Burma and published a monumental work on the fishes of those countries, stated that the

hollow superbranchial organ . . . enables the climbing perch to retain water for a considerable time, so that it can moisten its gills and live whilst out of its native element.

As has already been noted, this organ is dissociated from the gills and enables the fish to breathe atmospheric air when the gills can not be used. The gills function only when the fish is submerged; the superbranchial organ functions only when the fish is out of the water. In this species we have an example of a water animal which is in course of evolution into a land animal, or, perhaps more correctly, a normally water-breathing creature which has already ceased to depend entirely on its gills and ultimately may respire only atmospheric air.



THE AIR-BREATHING ORGAN OF *ANABAS*
It is this superbranchial structure, occupying a cavity over the gills, which enables the fish to absorb atmospheric oxygen. (From "*The Study of Fishes*" by Günther)

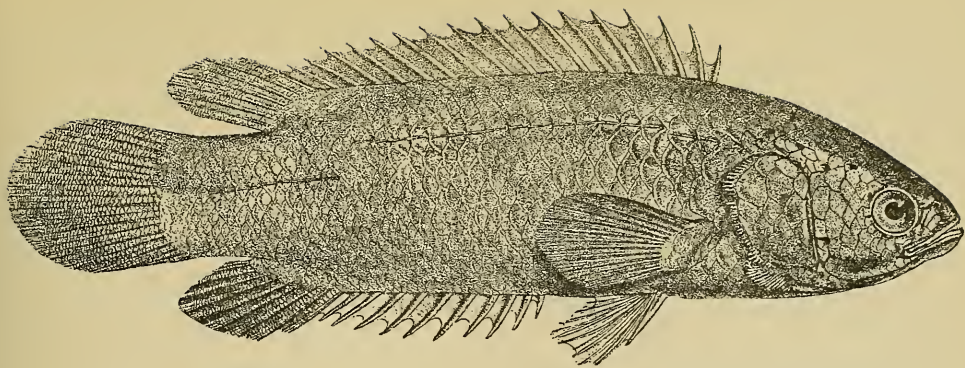
In the Dravidian language of Ceylon and India the name for *Anabas* means a tree climber, but the tree-climbing powers of the fish have been viewed with doubt or altogether denied by some of the leading ichthyologists of India. Thus, Doctor Day, in his work *The Fishes of Malabar* (1864), refrained from expressing a positive opinion, and said:

The climbing properties attributed to this fish in other portions of India and Ceylon are fully believed in by the inhabitants of Malabar. Certainly it is with difficulty that they can be retained in a vivarium as unless it is covered or its summit upwards of a foot from the water they invariably escape. They are able to progress along the ground in two ways, either by lying on their sides, flapping their tails, and moving their pectoral fins, or else chiefly by the aid of the latter fins, first one being advanced and then the other. They can erect their fins and likewise their scales at pleasure, even down to those at the base of the caudal fin. This power of erection, especially as it also exists in the gill covers, would be of great assistance did they employ the latter in climbing.

Dr. Francis Hamilton, in *An Account of the Fishes Found in the River Ganges and Its Branches* (1822), regarded the habit ascribed to this fish by Daldorff as non-existent and held that Daldorff's powers of observation were defective. Thus:

To what enjoyment this dangerous faculty of climbing trees could lead a wretched fish, I am totally at a loss to imagine, and I therefore believe that Daldorff was mistaken; but to what circumstance, neglected to be noticed in his narrative, the error should be attributed, I cannot take upon myself to say.

There is no reason why *Anabas* should climb trees as a regular habit, and in my rather extensive acquaintance with the fish in India, Burma, Ceylon, Siam, French Indo-China, Malaya, the Philippines, and some of the Indo-Australian islands I have never known one to climb a tree or to be found in a tree except at its base. But from what I know of the out-of-water movements of this fish I would have no difficulty or hesitation in accepting Daldorff's statement. A Palmyra palm, with its rough bark and its fronds beginning near the ground, would be no more formidable for an *Anabas* to ascend than would be the vertical side of a wicker basket. For a fish that for weeks or months may have been suffering from a deficiency of water, a stream of rain water flowing down an inclined palm trunk would have a strong appeal.



A FISH THAT DROWNS WITHOUT AIR

A drawing of *Anabas scandens*, taken from "The Fishes of India" by Dr. Francis Day.

The average length attained by *Anabas* is six inches

The climbing powers of *Anabas* are exercised chiefly in leaving its home in a pond, swamp, or canal and seeking other waters that may afford better living or feeding conditions. In making this change of quarters the fish may have to travel on dry land, and it is this habit which is characteristic and well known to oriental people. In Siam, I not infrequently came upon an *Anabas*, usually at night, crossing a dusty road or traversing a lawn or field. It was easy to discover the water which a fish was leaving but it was not always possible to determine the particular water to which it was heading. In some cases the body of water to which the fish was obviously bound did not seem to the human observer to be more attractive than the water which had been left. The banks of drying canals and ponds up which the fish has to climb may be high and steep, and skill and patience may be required to negotiate them; but on arriving at a new body of water the fish may exercise much less care in descending, and I occasionally saw one, apparently deliberately, roll or fall down a steep bank and go into the water with a splash.

As would be expected in a fish which regularly leaves the water and travels overland, *Anabas* displays no conspicuous color which might attract attention. The adult fish is of a uniform dark brown while the young is light brown, with a few blackish transverse stripes.

Walking powers

The walking powers of *Anabas* seem to be exercised only when in quest of a new aquatic

environment, and there appear to be no observations indicating that the fish regularly feeds when out of the water, although it may conceivably seize insects or worms that happen to be in its terrestrial path.

The walking movements lack the grace and ease of those of a lizard and of some of the gobies, such as the mudskipper (*Periophthalmus*). The gait is jerky but comparatively fast, and the efforts are usually persistent, so that a fish may travel a considerable distance in a short time. I have a note on the actually observed out-of-water movements of an *Anabas* in Peninsular Siam. This fish had been living in a small pool in a detached circular garden thickly planted with flowers and shrubs, but was removed when the pool was to be cleaned. It was taken by a servant for release in a stream on the edge of the compound. The servant, however, was called away and put down the basket containing the fish just before reaching the stream. The fish immediately climbed out and, instead of entering the near-by stream, headed back in the direction of the pool. Its subsequent movements were partly conjectured but were under observation during the latter half of the journey. The fish first passed through grass and then over a metalled driveway between houses; and on arriving at the garden it continued on the driveway to the far side and then made a short turn, plunged through the flower beds, and reentered the pool. The distance traveled was more than three hundred feet and the time occupied was about thirty minutes. This particular fish, in addition to progressing readily on dry land and

breathing atmospheric air, had well-developed aerial vision (which is rare in fishes) and seemed to exhibit a homing instinct.

Anabas is a valuable food fish in India, Burma, Siam, Malaya, China, and the islands lying off the southeast coast of Asia. Its importance to man arises from the inherent edible quality of its flesh, from the adaptability of the fish to almost any kind of water, and from its hardiness which permits easy handling in commerce. In Siam it is one of the staple foods over the whole country and is in great repute for its wholesomeness and for its invigorating quality in convalescence. The Siamese name is *pla mor*, or doctor fish. It is taken to market in tubs with little or no water and in wicker baskets, and is usually exposed for sale out of water; it apparently suffers little or no inconvenience from such treatment, its only requirement during a long day in the market being infrequent sprinkling with fresh water to keep its air-breathing apparatus moist.

Baiting for market

Various kinds of basket traps and nets are employed in taking Anabas for market; and the fish is much sought and easily caught by

youthful anglers using almost any kind of bait on a short line attached to a slender bamboo pole. In many places the children thus keep their families supplied with fresh fish.

A dangerous practice

Young Siamese fishermen sometimes insert the head of a newly caught Anabas between their teeth so as to leave both hands free to rebait and recast the line, while in India fishermen often kill their catch by putting the fish in their mouths and biting the backbone just behind the head. On rare occasions this practice has led to dire consequences, for the fish has given a jerk, wriggled into the back of the mouth, and become lodged in the pharynx, from which extraction is almost impossible owing to the strong backward-projecting spines on the sides of the head. When in Siam I learned of several deaths from suffocation when Anabas became tightly impacted over the windpipe of fishermen; and Dr. E. W. Gudger, of the American Museum of Natural History, has published accounts of these and many other cases in which oriental children and adults have been killed by having live fish wedged in the pharynx.



THE DISTRIBUTION OF ANABAS

The species described in the foregoing article occurs in estuaries and fresh waters of India, Ceylon, Burma, and the Malay Peninsula and Archipelago; and eleven other species occur

in Africa. So far as is known the African species never go tree-climbing or land-walking. (From "Cambridge Natural History," page 645)

The Wonders of Mount Rainier

New facilities aid the hiker and nature lover on the slopes of one of the most beautiful mountains in the American Northwest

By C. FRANK BROCKMAN

IN Mount Rainier National Park the greatest charm and most engaging interests, in spite of the beauties that are spread before the eyes of the motorist, are found along "back country" trails. Picture, if you can, a mountain whose broad base covers an area larger than that occupied by metropolitan New York City; whose ragged, icy crest stands more than eleven times higher than our greatest city's tallest building, and you have some idea of the huge dimensions of one of America's greatest volcanoes. The lavas which flowed from the earth destined to compose the base of this giant mountain laid a broad foundation—inundating approximately one hundred square miles of the original mountainous country.

A trail in wonderland

Encircling this peak is the Wonderland Trail, appropriately named, and one must spend from eight to ten days with pack sack or pack horse if one wishes to encircle Mount Rainier. In order to stand upon "The Mountain's" highest point, 14,408 feet above sea level, the climber must run the gamut of adventure on glacial ice and crumbling rock cleavers for the better part of two days.

So much for Rainier's size. A hasty observation of this national park from an airplane or an examination of an accurate relief model of the area will indicate the problems of the hiker, as well as the varied interests that lie along his path.

For 115 miles the Wonderland Trail wends

a tortuous way through dense forests, across broad glacial gorges, traverses flower-strewn alpine meadows, and alternately ascends and descends lofty, windswept ridges.

The mountain squats just to the west of center within the park's boundaries, its twenty-eight tongues of glacial ice radiating from its upper elevations and penetrating deep into the heavily timbered zones far below.

Ups and downs

Thus a trip encircling Rainier is largely a series of ups and downs. A cross section of the route traveled would look like a graph of stock market trends, for the glacial canyons, radiating from the mountain like spokes of a wheel, alternate with numerous ridges which separate them. Often a day's travel carries the hiker across several such canyons and their adjoining ridges, the difference in elevation between valley and ridge-top occasionally being in excess of 5000 feet.

But as one alternately climbs and descends, he has this to console him and ease his efforts—figuratively he is shod with the fabled "seven league boots." Keep in mind that a change of 1000 feet in altitude brings about climatic changes corresponding to a 300-mile change in latitude, and one can visualize the powers of this imaginative footgear. As one ascends, he passes through several altitudinal zones—Transition perhaps, then Canadian, Hudsonian and Arctic Alpine. The character of plant and animal life in these zones is very similar to the latitudinal zones of like names to the north, because of climatic conditions therein that are

very much alike. Thus, with every step upward, one figuratively is striding with giant steps into the north, and, descending, one retraces these mythical Gargantuan paces southward.

Until a few years ago it was necessary, in order completely to encircle the mountain via the Wonderland Trail, either to carry provisions on one's back for the entire journey or hire a number of pack animals. Both methods were accompanied by serious objections. To carry all necessary food and paraphernalia on one's back for a two weeks' journey over this rugged country is a fatiguing pastime. The latter method had an equally obvious objection because of its expense.

Now, because of a partly completed road system, one may easily reach several "key" points within this national park. At each one, with the exception of Carbon River where only a public camp ground is found, there are available hotels, housekeeping cabins, public camp grounds, and allied features. By hiking out along the trails that converge at each of these spots, one may cover all accessible country within a particular section. One then merely drives to another point and repeats the process.

Another method that is worthy of interest is first to visit each of these "key" points, leave a cache of supplies designed for a few days' travel at each, and then replenish the pack sack from these as Mount Rainier is encircled.

Conveniences for the hiker

Along the trails one finds, at distances approximating a day's travel, rustic shelters and fire pits for the convenience of the hiker. Here one may make himself comfortable and be largely free from the vagaries of the weather. Hikers have the C.C.C. to thank for these shelters, for it was the efforts of the boys in this organization that made them possible.

Glacial activity in the past has fashioned the topography of this region and set the stage for such scenic gems as Comet Falls. Here, in a narrow, glacial-carved glen, one sees a slender stream plunge over a 250-foot precipice, its waters cascading downward in numerous comet-like masses which account for the name. Its spray bathes the rock and earth in the vicinity with a filmy mist that enriches the floral life of this spot. It is a pleasant place in which to

stop and rest on the way to Van Trump Park, where numbers of mountain goats may be seen in their native habitat.

But man was not the first to discover the cooling advantages of this place. During the warm days of late July and early August when that pestiferous insect, the deer fly, is particularly obnoxious to many four-footed animals, I have shared the spray of Comet Falls with numerous deer which find in the cooling mist a ready relief from the pugnacious activity of these flies.

The higher slopes

The goats, upon the higher slopes, have their own particular way of avoiding the heat of midday. Often, while crossing the ice of Van Trump Glacier, I have seen shallow hollows on its surface, melted by the warmth of the bodies of these animals as they reclined upon nature's refrigerator. Mostly one sees the goats from a distance, stepping gingerly about over some precipitous cleaver, but occasionally one has the good fortune to get better acquainted with them.

I recall one instance when, after a hard climb into Van Trump Park in a soggy fog, we were on the point of leaving, disgusted with the state of the weather. As we debated the advisability of retracing our steps, the wind changed, and quite suddenly (for one never can understand the weather here) the fog dispersed. With its dissolution we discovered that we had wandered into part of a large band of goats, but the animals already were moving rapidly away. Without the slightest sign of confusion but, nevertheless, with a well-defined purpose of retreating to higher and more inaccessible ground, the goats ambled toward a near-by rocky cliff. More than sixty individuals were counted, and thus an otherwise disappointing day was transformed into one of great satisfaction.

One must admit, however, that the bane of the hiker on any extended trip about this old mountain is the weather. Mount Rainier has temperamental moods akin to those of the most fabled prima donna, so, while the summer months are generally pleasant, it is wise to be prepared for storms. A light waterproof garment, such as a silk weather-proofed parka, is essential, for rain, fog, and, on the higher por-

tions of these trails, snow are often encountered Too, these periods of bad weather are not the usual temperamental mountain storms. They may last for days and cause considerable discomfort to those not prepared.

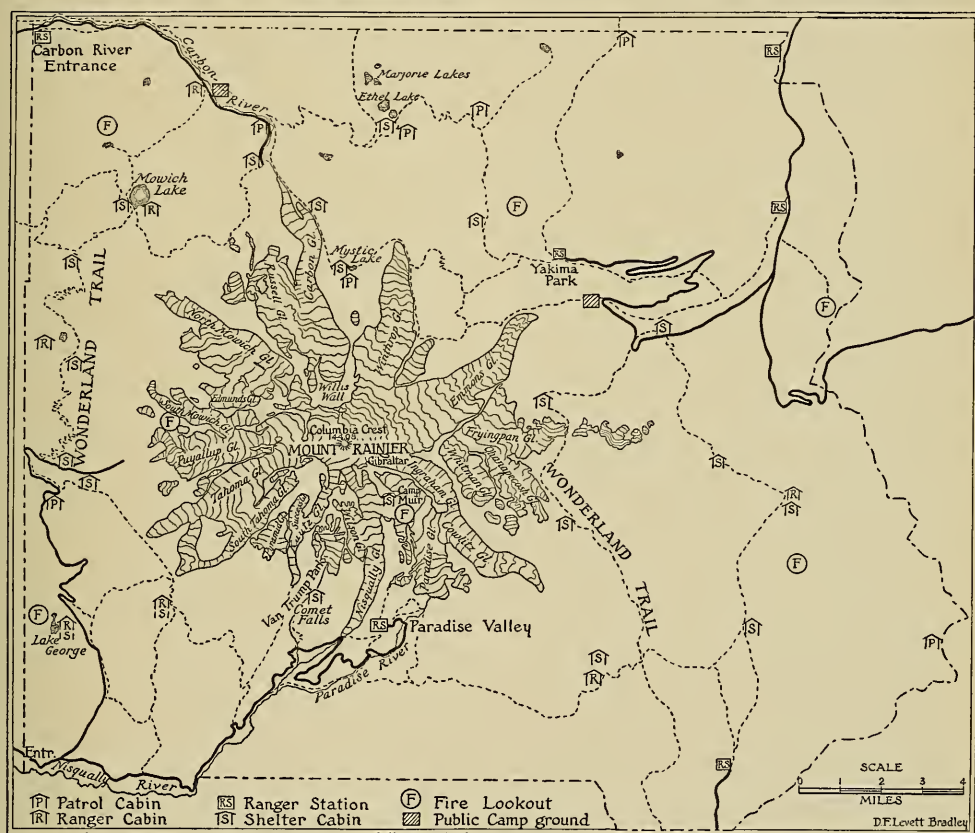
As the hiker encircles Mount Rainier, he is forced to swing wide about the ends of the long tongues of glacial ice. There are twenty-eight of these, approximating a surface total of fifty square miles. He crosses streams that rush forth full born, from beneath the discolored ice, for the major park streams which have their origin in the gradually receding glaciers are not of the type that decrease greatly in volume near their origin. And the power of these swift streams is tremendous; one has but to listen as boulders of all sizes pound and crunch against one another, to realize that a misstep in crossing such a torrent would be fatal.

Intermixed with rock débris cut from the

mountain by the moving ice in years past, the termini of these glaciers present a sorry appearance. From a distance they look like great piles of coal, but, upon close approach, one sees that they are really ice. Their dirty appearance, while disappointing in one way, tells a dramatic story of the power of moving ice.

As the glacier nudges down the mountain side, it is constantly cutting deeper into Rainier's flanks and undermining the steep canyon walls. Rock falls upon the ice surface, forming knife-edged lateral moraines near the sides of the glacier, and this débris is slowly carried downstream where, at the snout, it covers almost the entire surface of the glacier.

Great boulders quite often roll pell-mell from the face of the ice at the snout, and numerous rills from the melting surface ice add to the volume of water that thunders from beneath the lip of the glacier.



MOUNT RAINIER, WASHINGTON

The long tongues of glacial ice radiating from Mount Rainier are gradually undermining its steep canyon walls. They approximate a sur-

face total of fifty square miles. The boundaries of Mount Rainier National Park are shown above by the dot-and-dash lines

Those of us who have an opportunity to see these glaciers at regular intervals note a constant change in their appearance. And annual recession data give evidence of the fact that, in spite of a downward flow that sometimes reaches a maximum of twenty inches a day, these "rivers of ice" are slowly becoming shorter at an average yearly rate of seventy feet. The accumulation of snow at the upper elevations is not sufficient to offset the melting at the snouts.

Climate of course influences the rate of recession. During the year period 1933-34 these glaciers melted back in some instances more than twice the average amount. The explanation lies in the long period of drought which affected practically every section of the country to some degree. Although the effect of this dry spell was not otherwise readily apparent along the habitually moist and humid northwest coast, it showed in the record recessions of Mount Rainier glaciers.

Historical records fortunately yield clues to the position of Nisqually Glacier as far back as 1857. It was in that year that Lieut. A. V. Kautz, with four companions, made his historic and heroic though unsuccessful attempt to ascend Mount Rainier. This was the first attempted ascent on record and in Kautz's journal an excellent word picture of the terminus of Nisqually is given, which enables us to identify its position in that year. Today a modern highway crosses the Nisqually River over 200 yards above that point. Other records indicate that about 1885 the glacial ice rested approximately upon the site of the highway bridge. In that year the Longmires, who had established a hotel about five miles below this point, used to make occasional trips to the snout of the Nisqually and chip pieces of glacial ice from the glacier to be used in the refrigeration of perishable foods at their pioneer backwoods hotel. Today the terminus of the Nisqually chokes the narrow canyon almost a half mile above that spot.¹

The Nisqually has the honor of being the first glacier in our country to become accessible by road and, in 1908, while the first motorists may have experienced considerable discomfort characteristic of motoring in those formative days of the automobile, they nevertheless had the pleasure of driving to within practically a stone's throw of the wall of ice. Today visitors to this spot must content themselves with a more removed view of the glacier's terminus unless they walk up the trail that is provided for that purpose. Those who return to the park periodically never fail to notice considerable variation in the appearance of the Nisqually's snout with each visit.

Glaciers, living and dead

Besides receding up its valley, the glacier is of course also moving downward. Experiments conducted on one or two occasions have shown that the downward flow of the glacial ice reaches, on hot summer days, a maximum of twenty-four inches. Roughly speaking the average maximum downward flow is 175 feet per year. As the average annual recession for the Nisqually is, for recent years, 72 feet, a total of about 225 feet of the glacier melts away each year. When one considers that the snout, roughly rectangular, forms a wall of ice about 75 feet high and 200 feet wide, one can readily see that considerable ice melts away. Herein lies a partial explanation of the volume of the river that rushes off, full born, toward the sea from this point.

Glaciers of this type are known in local parlance as "living" glaciers. In short they have a perceptible downward flow due to gravity and other causes and are still carrying on their work of gouging out their deep, awe-inspiring canyons. During their greatest activity on hot summer days, the streams that come from them are murky with countless tiny particles of ground-up rock known as "glacial flour."

A second type, known locally as a "dead" glacier, does not move downward. At one time perhaps such a glacier was of much greater size, but it was forced to recede just as the Nisqually, the Emmons, the Carbon, and the South Tahoma are doing, to a shelf or basin high upon the flanks of Mount Rainier. There, owing to the topography, it lies stag-

¹ The tabulation of the recession of the Nisqually, which is generally considered as the third largest glacier in the United States, is as follows:

1857-1885.....	760 feet	1925-1926.....	86 feet
1885-1892.....	140 feet	1926-1927.....	43 feet
1892-1918.....	1310 feet	1927-1928.....	89 feet
1918-1919.....	59 feet	1928-1929.....	52 feet
1919-1920.....	46 feet	1929-1930.....	118 feet
1920-1921.....	106 feet	1930-1931.....	49 feet
1921-1922.....	67 feet	1931-1932.....	50 feet
1922-1923.....	44 feet	1932-1933.....	44 feet
1923-1924.....	83 feet	1933-1934.....	155 feet
1924-1925.....	73 feet	1934-1935.....	54 feet

nant and shows little if any downward flow. Most famous of these dead glaciers in Mount Rainier National Park is the Paradise, and for many years great ice caves were its outstanding feature. For a time, as we are able to ascertain from old photographs, it receded rapidly but now it seems to have slowed somewhat in its mad retreat.

Rainier's glacial system

What is the reason for the existence of this great glacial system on this mountain? It is not simply the altitude of Mount Rainier for there are other mountains which are slightly higher above the level of the sea. Both Mount Whitney in California and Mount Elbert in Colorado may boast of greater elevation but neither possesses glacial systems. The reason is snow. Upon the broad flanks of this huge volcano, due to the great amount of moisture that is swept inland from the Pacific in the prevailing winds, occurs one of the heaviest snowfalls on record in our country. At Paradise Valley (5557 feet), which is widely known for its wild flowers during the summer season, it is not unusual for twenty-five feet of snow to be found upon the ground in mid-winter, while unquestionably a great deal more snow falls at the higher levels where most of the glaciers are born. This snow, in packing down, is transformed into glacial ice and keeps alive these remnants of the "ice age." Each winter it partly repairs the damage of the warm summer sun but the glaciers are fighting a losing battle. Eventually, perhaps, at some time in the distant future these great glaciers, some of which are more than four or five miles long today, may be mere traces of their former magnificence.

Higher on the mountain flanks the ice is crystal clear. The morainal material that renders it so ugly near the snouts gradually becomes less pronounced in volume as one traces the course of these glaciers to the summit. And with these changes in conditions comes also the necessity for a new technique and special equipment if one is to penetrate into this rigorous land of perpetual snow and ice. The National Park Service exercises strict supervision over all parties who venture into such dangerous places.

When one contemplates "hitting the high

spots" on Mount Rainier, he should not be without the parka, already mentioned—which in the high elevations will serve as a windbreak as well as protection against snow, a pair of crampons, an ice axe or alpenstock, caulked boots, dark glasses to protect the eyes from the sun's glare upon ice and snow, and the usual warm clothing necessary for such ventures. In addition, each party must have a satisfactory rope with which to rope over or around bad places in the route to Rainier's crest.

The first ascent, made by Stevens and Van Trump in 1870, was accomplished by what is known as the Gibraltar route because of a large, blocky obstacle, along the face of which one must climb, that stands on the way just above the 11,500 foot level. It is over this route that most of the ascents are made today, though Mount Rainier has been climbed successfully by means of several other routes on numerous occasions. The route from Yakima Park over the Emmons Glaciers is probably the most generally used of these secondary ways of ascent.

From Paradise Valley at 5500 feet one sees the blocky Gibraltar jutting from the flank of Rainier, and on the way up the climber has this landmark in front of him until early morning of the second day of the ascent. The start of this climb is made just after noon, and wise is he who chooses his dinner with an eye to the physical efforts of the climb. Woe be to the man who gnaws merrily at a juicy steak at this parting repast, for such gustatory delights have a habit of turning one's stomach inside out at the higher elevations.

At ten thousand feet

At about six o'clock, the flower meadows having long since been left behind, two stone cabins at the 10,000-foot elevation offer a welcome haven for a few hours. A bit of light lunch is enjoyed; warm tea is sipped, while the eye feasts upon a glorious panorama of tumbled, jagged peaks that stretch away to the south in endless rows. Upon the horizon loom sister volcanic peaks of Rainier—Mount Adams, Mount St. Helens and Mount Hood. Near at hand is "The Mountain" itself, with its writhing mass of cold, bluish ice offering anything but a ready welcome.

One seems surrounded by a labyrinth of cold ice and forbidding rock cleavers, great, yawning crevasses, and overhanging bergschrunds. With such a fantastic picture in mind, one turns in and tries to get a bit of rest and possibly sleep. The last lap of the climb and by far the most dangerous and thrilling part is begun at about 1:00 A.M. Climbers must return to Camp Muir—the resting place at the 10,000-foot elevation—by noon, for the warm sun's rays which strike the southwest face of Gibraltar with great energy after that time, dislodge rock and ice that pelt the narrow ledge along which one must climb.

The base of Gibraltar is attained at about daybreak and there, at a spot known appropriately as Camp Misery, those who are unable to continue farther are left in a sheltered place until the return of their party. After one leaves the camp, the numerous leering crevasses that one views far below from the precarious footing of the Gibraltar ledge do not help the peace of mind of any timorous individual.

On to Rainier's summit

But the climb is just about under way. At the upper level of Gibraltar one again takes to the glacier. Here the ice is badly broken up. In fact, the entire Gibraltar route is becoming more dangerous each year as the ice becomes more forbidding and the narrow ledge trail slowly sloughs away. From the upper part of Gibraltar to the summit the climber is forced to pick a meandering trail through a maze of broken-up ice. Occasionally snow bridges are crossed. Often it is necessary to climb via a

tortuous route around some particularly dangerous crevasse where no other method of crossing seems available. Above, the summit—or rather the crater rim just under the summit—seems to mock at one from a gradually receding distance. One's knees seem to be of rubber after a couple of dozen steps, and breath comes in short, labored gasps. And then, quite surprisingly, the rocks of the crater rim are achieved.

A force that defies familiarity

It is a glorious sensation, this final achievement of the crest of Rainier. After a short rest one may care to hike around the rim of the small crater to Columbia Crest, the highest point and 14,408 feet above the level of the sea. There are only two other spots in the United States higher than this—the summits of Mount Whitney and Mount Elbert. But Rainier rises from a comparatively low base level, and in climbing from Paradise Valley one ascends a total vertical distance of almost 9000 feet. No wonder one feels as though he has “been some place” upon the return.

And, so, to know Mount Rainier National Park *intimately*, one must have had the experience of hiking its many miles of trails and climbing about on its awe-inspiring crags and glaciers. Its moods are those of a harlequin, a “Dr. Jekyll and Mr. Hyde” in ice and stone. Each day, each hour brings new and delightful changes that will thrill the hiker and fascinate the student of natural history. We, who live in its shadow, see in its changeable nature a dominant force that defies familiarity.

MIRROR LAKE

(Opposite page) Up is down when you view Mount Rainier in Mirror Lake, in Indian Henry's Hunting Ground. With pack sack or pack horse one can encircle the mountain in eight or ten days

The Wonders of Mount Rainier





Emmons Glacier shown above is the largest "river of ice" in the United States. Twenty-seven other glacial tongues radiate from this mountain. Photograph by Asahel Curtis

Snow bridges such as this one span deep crevasses, and the climber sometimes is able to cross by them; but extreme caution must be exercised lest the bridge be too weak





A typical crevasse in the surface of one of Mount Rainier's glaciers. The ice of these glaciers is in places many hundreds of feet thick. Photograph by Asahel Curtis

“RIVERS OF ICE”

Mount Rainier's glaciers are shrinking. In spite of a downward flow that sometimes reaches twenty inches a day, they are gradually becoming shorter at an average rate of seventy-five feet a year. There is not enough snowfall on the upper levels to offset melting. Perhaps in some far-distant age the mountain will be bare of ice



*Excellent highways lead the
within the park where the major
a portion of the highway near
east corner of Mount Rainier*

*Comet Falls. Glacial activity carved
the glen in which this slender stream
plunges over a 250-foot precipice.
Here mountain goats may be seen,
amidst rich floral life. Photograph
by C. F. Brockman*



motorist to several "key points"
 trails converge. Above is shown
 Yakima Park in the north-
 western National Park



Dangerous crevasses sometimes obstruct the climber on Rainier's glaciers. Special technique and equipment are necessary if one is to assault this rigorous land of perpetual ice and snow



(Above) One of the dangers of mountaineering—a giant bergschrund or crevasse in the snow slope at the head of a glacier. Ladders are sometimes used in crossing such obstacles

(Upper right, opposite page) Mowich Lake. Shelter cabins are found along the trails about a day apart. For 115 miles the Wonderland Trail winds through

dense forests and traverses glacial gorges, flower-strewn alpine meadows, and wind-swept ridges. Photograph by C. F. Brockman

(Right, opposite page) A summit party resting at Camp Misery. Here one looks down upon the Cowlitz Glacier stretching away into the lowlands beyond



The New York State Theodore Roosevelt Memorial

A utilitarian and artistic symbol of the life and ideals of a great Statesman, Naturalist, Conservationist, Explorer, Humanitarian, and Patriot

WHEN on January 19 the New York State Theodore Roosevelt Memorial adjoining the Museum was dedicated for public use, a dual purpose was achieved. A splendid architectural monument was consecrated to the memory of Theodore Roosevelt, the statesman, explorer, and nature-lover, and additional educational facilities and opportunities were added to the American Museum of Natural History.

"We know how he loved the great outdoors," said President Franklin D. Roosevelt at the dedication. "He loved the life of the boundless plains which he had known as a rancher in the West. He found strength in the wilderness. He knew the birds and the animals and the trees and the plants and the flowers. . . . His volumes on American history, on current problems, and on his own experiences as a hunter and explorer, captured, as we know, and retained the interest of the American people."

Building portrays broad attributes

It was Henry Fairfield Osborn who after Theodore Roosevelt's death seventeen years ago advocated the erection of such a memorial and devoted his continued efforts toward it.

"Many people and many groups have, in their own way, memorialized Roosevelt's life in thought, word, and deed," Mr. A. Perry Osborn, son of the late President of the American Museum pointed out. But "it was given to one man—a boyhood and life-long friend—to conceive an enduring and inspiring

Memorial." It was planned that the building "should be simple in architecture yet splendid and heroic in dimension . . . that it should possess warmth yet useful purpose, making its appeal to all men. Thus, the building should have the very characteristics of the man it memorialized."

Competition for design

In 1925 the Board of Trustees invited the leading architects of New York State to submit plans in competition. The design which won the award was that of John Russell Pope.

Another competition, in which twenty-five leading artists anonymously took part, was held for the selection of the murals. The design submitted by William Andrew Mackay was selected.

Describing the purport of these gorgeous panels, Governor Herbert H. Lehman said: "On the walls of this great hall . . . there are painted scenes depicting the accomplishments of a great president: acts of physical courage—undertakings which resound to the glory and profit our nation."

Some intimate glimpses of Theodore Roosevelt were given at the ceremony by his son Theodore, Jr.: "At home I have a battered volume of Wood's *Natural History* in which his name is scrawled in a boyish hand. It was his first nature book. While reading it, his artistic sense evidently overcame him, for the picture of the elephant is extra illustrated with a platoon of little figures of this single-line school, which are chopping at the elephant's

back and legs with what look like knives and axes. In other convenient places he has drawn strange animals that I am sure, in later life, he would have characterized as nature fakes.

"His love of nature began when he was very young. By this time he was only ten or twelve and he was really actively interested. His father, another Theodore Roosevelt, helped and encouraged him in every way. There is a family story telling how his eldest sister objected when she found he was keeping dead mice in the ice box. He is supposed to have remarked solemnly on hearing this that she was obstructing the course of science. . . .

"We in the family believe that my father would be very proud of this Memorial we are dedicating today. It deals with natural history, of which he was so fond, and will benefit the people of the country to whose service he dedicated his life."

Secretary George N. Pindar, of the Board of Trustees of the Memorial, describes the building as follows:

"The façade is executed in a pinkish granite from Massachusetts. On the parapet wall surrounding the terrace are carved inscriptions indicative of the fullness of Roosevelt's life as follows: Ranchman, Scholar, Explorer, Scientist, Conservationist, Naturalist, Statesman, Author, Historian, Humanitarian, Soldier, and Patriot. Upon the pedestals supporting the exterior columns and the pedestals flanking both ends of the terrace, which is 350 feet in length, Edward Field Sanford, Jr., the sculptor, has carved in bas-relief the figures of animals native to America and Africa.

"In the center of the terrace, immediately in front of the great entrance arch, upon a polished granite pedestal, will be an equestrian statue of Roosevelt with two accompanying figures on foot, one an American Indian and the other a native African, representing his gun bearers and suggestive of Roosevelt's interest in the original peoples of these widely separated countries. This group will rise to a height of thirty feet above the sidewalk. It is the work of James E. Fraser, the well-known sculptor, who designed and executed the four statues that surmount the great columns on the main façade.

"The niches at either side of the entrance are planned to hold sculptured figures of two typical specimens of American big game, the

bison and the bear. It is intended that the bear shall typify courage, tenacity, and power; the bison, romance, fortitude, and endurance, dominant characteristics of Roosevelt. . . .

"Passing through this entrance, one steps into the Memorial Hall itself, a conception of grandeur and dignity in harmony with the spirit of Roosevelt's lofty ideals and fearless character. This hall, exclusive of recesses, is 67 feet wide by 120 feet in length. The floor is richly patterned in marble mosaic, the walls to a height of 9 feet, being of St. Florient cream marble surmounted by mellowed limestone extending to an elaborate Corinthian cornice and culminated by an octagonal coffered barrel vault, reaching to a height of 100 feet above the floor. . . .

Utility with beauty

"From the practical and educational standpoint the building is splendidly equipped with class rooms, exhibition rooms, a lecture hall, a hall for the display of the resources of New York State, and a room devoted to Rooseveltiana. At the right of the entrance vestibule are located the administration offices or Trustees' Room, while at the left is a group of superbly finished panelled butternutwood interiors, forming a suite of rooms to be known as the Statesmen's Rooms. A cafeteria and lounge are located in the basement."

In the dedication ceremony A. Perry Osborn called attention to the harmonious combination of utilitarian and artistic ideals: "The first two floors serve as an entrance to the Museum, useful and adequate. The upper portions of the building contain study rooms, work rooms, and a lecture hall to serve educational purposes. . . . Here people who come will find peace and quiet, and in the nobility of these surroundings will think of the man for whom this Memorial stands both as a tribute and as a symbol of his greatness. Here people will find help for their own lives and inspiration to serve humanity and country. Meetings of our citizens will be held in the Memorial for objects in which Roosevelt was interested, and so broad were his interests that these meetings will take in the range of human activity.

"What an appropriate, useful, beautiful, and inspiring Memorial this is, an honor to all its creators as well as to the man it honors!"



Photo by Charles Phelps Cushing

THE ENTRANCE HALL

The grandeur and dignity of this hall are in harmony with the spirit of Roosevelt's lofty ideals and fearless character. Recesses on three sides contain murals like the one in this photo-

graph. The Roman Corinthian columns, 48 feet high, are executed in red antique marble. The vault reaches to a height of 100 feet above the floor

The New York State Theodore Roosevelt Memorial



Photos on these pages by F. J. Hart

THE SOUTH

(Above) Theodore Roosevelt, at lower left, is shown with delegations from Russia and Japan gathered to negotiate for peace in the Russo-Japanese War—1904. Death, Famine and Plague are represented at the top

(Left) Events in old Russian history are represented here through several historic personages of the period before 1000 A.D. At the bottom are shown the ancestors of the Roosevelt family, their names above them



WALL MURAL

(Above) This panel is the Japanese counterpart of the one opposite, showing that both nations face the same loss and ruin which follow war. At bottom Justice and Mercy are shown separating the belligerent armies

(Right) Japanese spiritual beliefs are here represented in the figures of various gods and goddesses and in the first historic Japanese emperor, descendant of the Sun Goddess. At the bottom are the maternal ancestors of Theodore Roosevelt





(Above) Theodore Roosevelt stands over a Nubian lion and lioness. Several birds which completed the collections at the American Museum and in Washington are included



(Above) In a tangle of gnarled trees, hemmed in by rocks, an African elephant is captured by a group of native hunters with shields and spears

(Below) The panel below illustrates an episode of Biblical history pertinent to Africa—The dispersal of the sons of Noah after the Flood. Photos on this page by F. J. Hart



A Federation of Wildlife Interests

A congress of individuals interested in conservation meets in Washington at the call of President Roosevelt

THE North American Wildlife Conference met in Washington, D. C., February 3 to 7. This gathering was called by President Roosevelt who stated "My purpose is to bring together individuals, organizations, and agencies interested in the restoration and conservation of wildlife resources. My hope is that through this conference new coöperation between public and private interests, and between Canada, Mexico, and this country, will be developed; that from it will come constructive proposals for concrete action; that through these proposals existing State and Federal governmental agencies and conservation groups can work coöperatively for the common good."

It was estimated that 2000 or more delegates attended the many sessions which centered about the Hotel Mayflower as headquarters. It was probably the greatest assemblage of representatives from all of the various wildlife agencies ever brought together for the common good, namely, conservation of wildlife.

The primary purpose of the Conference was the formation of a *General Federation of Wildlife Interests*. At an early meeting, an outline for the proposed General Federation was first presented to the delegates. In brief, this plan provides for the welding of all wildlife interests into a super-organization with headquarters at Washington. Each State will have one representative in this Federation, and provision is also made for representation from nation-wide organizations and societies. For the purpose of administration a board of trustees is to be set up, the board consisting of members selected from thirteen regions into which the United States is divided, and an additional six members at large. The State representatives must be selected by a general caucus of all interested parties in a State and in the manner provided by the constitution and by-laws of the Federation set up in that particular State.

The potential usefulness to conservation of such a plan is based upon the organization of local interests. When there is need for concerted action on the part of those who believe in any phase of wildlife conservation, the best avenue for reaching a legislature is by way of the local constituency. The Federation headquarters at Washington will operate as a transmitting agency to pass along facts to the very bottom of the Federation organization, namely, the counties. Acting upon advice from Washington, the organized local interests may very effectively communicate with Con-

gressmen and place their views upon record in a manner most likely to receive attention. If matters of conservation policy are made topics of immediate interest throughout the Nation, it should not be long before Congressmen can be made to feel that wildlife must be taken into consideration. As a matter of practical application of democratic principles, it would seem that this idea offers a better opportunity for constructive wildlife planning than does the present desultory sniping away at legislators by a host of unorganized conservationists.

After considerable informal discussion, the proposed constitution for the General Wildlife Federation was formally presented for a vote on the afternoon of Wednesday, February 5. By a unanimous vote a constitution was approved to operate for the first year. Because of the difficulties inherent in a large-scale operation of this sort, it was realized that many of the first steps should be tentative and that some time would undoubtedly elapse before a smoothly running machine could be set up. The ultimate success of the Federation will depend upon the degree of coöperation received from the many and various interests which may be logically included under the conservation banner. Any aggressive move for domination of the Federation by a particular group will certainly create distrust and suspicion and will militate against the success of the undertaking, and it will be necessary to adopt a policy of give and take without undue emphasis upon the latter. The project was launched to a most auspicious start upon the election of Mr. J. N. ("Ding") Darling as the president of the Federation. The spontaneous endorsement received by Mr. Darling whenever he appeared before any gathering at the Wildlife Conference indicated beyond any shadow of a doubt that if any individual could swing all of the varied conservation interests into line, this man was "Ding" Darling.

The focus of attention shifts now from Washington to the local activities of the "wildlifery," and the success or failure of the Federation depends upon the degree of harmony achieved in the merging of common aims and submerging of selfish interests. It is to be hoped that all will pull together for the Federation and that the American public will become not only wildlife conscious but sympathetic to the needs of wildlife conservation.

—H. E. ANTHONY.

Science in the Field and in the Laboratory

Exploration, Astronomy, Education, Exhibits, Research, New Members, Lectures

Edited by A. KATHERINE BERGER

The Fleischmann-Clark Indo-China Expedition

The Fleischmann-Clark Indo-China Expedition of the American Museum of Natural History sails on the "President Coolidge" from San Francisco on Friday, February 21, to engage in an extended collecting trip, starting for the jungle from Saigon.

The members of the expedition are Major Max C. Fleischmann, of Santa Barbara, well-known sportsman, big-game hunter and fisherman, and Dr. James L. Clark, director of the department of arts, preparation and installation at the American Museum. Both men have a wide experience in the field.

Major Fleischmann has hunted throughout America, in Central Asia, and in Africa. Doctor Clark, in addition to his lesser hunts in Wyoming and Canada, went as co-leader of the Morden-Clark Expedition to Russian Turkestan after the *Ovis poli*, and to the Thian Shan Mountains for ibex; again, as co-leader of the O'Donnell-Clark Expedition to Africa after giant eland on the Upper Nile; and also as co-leader of the Carlisle-Clark Expedition after lions in Tanganyika.

The object of the Fleischmann-Clark Expedition is to obtain as many varied specimens as possible from the interior of Indo-China for purposes of scientific study. Wildlife there, as elsewhere, is on the wane and it is of the utmost importance that the mammal collections of the Museum should be supplied with all forms of fauna obtainable, before they become extinct. The expedition expects to hunt the tiger and the wild buffalo and to collect a multitude of the smaller mammals of the region. Photographs by motion and still cameras will be taken for the Museum's educational work.

Snyder Colorado Expedition

At the generous invitation of Mr. Harry Snyder, Mr. George G. Goodwin, assistant curator of mammalogy, spent six weeks collecting on the western slopes of the Rocky Mountains in Colorado. He returned to the American Museum on January 6, bringing back 3 elk, 4 mule deer, and 150 small mammals, including coyote and lynx.

Collecting was done at elevations between 6,000 and 10,000 feet, and at temperatures averaging 14° below zero.

Hitherto the Colorado material in the Museum has been rather inadequate, and it is gratifying to receive the present series for its collections.

It is of interest to note here that this is the third expedition that Mr. Snyder contributed to the Museum during 1935.

The Archbold New Guinea Expedition

The 1936 New Guinea Expedition, one of the series of expeditions organized and led by Mr. Richard Archbold of the American Museum of Natural History for the biological exploration of New Guinea, left New York the early part of this year to collect natural history specimens in South New Guinea, on the upper reaches of the Fly River, and the mountains beyond.

Besides being fully equipped with collecting materials, the present expedition is taking with it portable radios and a new Fairchild amphibian airplane which Mr. Archbold has called the "Kono," a native name for a rare duck which lives on the mountain lakes of the interior of New Guinea where the expedition hopes to explore.

Mr. Archbold, himself a mammalogist, returned from New Guinea in May, 1934, after leading a very successful expedition into Southeast New Guinea, collecting mammals, birds, and plants. The scientific members of the present party will include, in addition, Dr. A. L. Rand, assistant leader and ornithologist and Mr. L. J. Brass, botanist, both of whom were also with the 1933 expedition, and Mr. G. H. H. Tate, mammalogist. The airplane party will consist of Mr. Archbold, who is also pilot, Mr. Russell R. Rogers, co-pilot and mechanic, and Mr. Ewing C. Julstedt, radio operator. Another white man will be picked up in New Guinea to look after the land transport of the inland party.

The expedition plans to concentrate on collecting mammals and birds for the American Museum of Natural History, and plants for the New York Botanical Society. It is also planning to make collections of cold-blooded vertebrates and insects.

Living palm seeds are to be collected for the Coconut Grove Palmetum, Florida, where it is hoped it will be possible to grow indigenous New Guinea species of palms. Besides the collection of land fauna, Mr. Archbold is planning to collect porpoises and sea turtles in the Torres Straits. There is a cockpit in the very bow of the plane. Here the collector with a harpoon gun will be stationed. After locating the porpoise or turtle from the air, the plane will land on the water and taxi up within range of the beast. As well as collecting specimens, an effort is to be made to study the habits and habitats of the birds and mammals and to make a complete study of the displays of some of the birds of paradise.

The party plans to reach New Guinea in March. A base camp will be established on Daru Island near the mouth of the Fly River. This will be the airplane headquarters where stores will be received by boat and from which the inland flights will start.

From Daru a number of reconnaissance flights will be made first over the head waters of the Fly River to discover the most promising and accessible areas for field work. Then the inland party, consisting of Doctor Rand, Mr. Brass and Mr. Tate, with about thirty native carriers, will be flown about 550 miles up the Fly River. The river here is several hundred yards wide so that the plane can land here, and an advance base is to be constructed in case of emergencies. The ground party will then proceed inland on foot, attempting to reach the highest altitudes, keeping in touch with the base camp and the airplane by means of a portable radio and being supplied with food stuffs by the airplane while on the march.

The inland trip

The inland party will make the first collecting camp the farthest inland and as high as possible, probably about 150 miles inland beyond the advance base at the river landing and at 10,000 feet altitude on the Dap range. The carriers will bring in only the barest necessities for traveling. The rest of the equipment will be flown in by plane. Two or three times monthly the Baby Clipper will fly inland with supplies from Daru. These supplies are to be landed by parachutes which are to be loaded with one hundred pounds of food or collecting materials. From experiments conducted in Florida during November and December of this year, Mr. Archbold found that about 130 feet from the ground is the proper distance to release the parachute. An automatic rip-cord attached to the plane opens the chutes and the load floats gently down to land in the camp clearing of the inland party.

An expedition depending upon the old type of transport by native carriers would have to get along with the barest necessities, but with this modern airplane transport a full allowance of necessities as well as a few luxuries can be landed. A scheme for picking up packages by plane has yet to be perfected, so there still remains the problem of carrying out the collected specimens to the

river landing, where the plane will receive them.

A receiving and sending short wave radio set is to be carried by the inland party to keep in touch with a similar radio set which is to be carried in the plane and another at the base camp. Thus each night it will be possible for the exploring party to carry on a conversation with the base camp. The necessary supplies can be requested and the progress of the work reported.

An unexplored area

The interior of New Guinea is one of the few unexplored areas in the world, areas that are still blank on the maps. The Fly River was discovered by Captain Blackwood of H. M. S. "Fly" in 1843. It was ascended for the first time by the pioneer naturalist D'Albertis in 1873. D'Albertis, to whom we owe the only natural history collections from this area, ascended to about 500 miles. Sir William MacGregor gave an excellent account of the river up to about 600 miles in 1890 but he was unable to reach the mountains. A few expeditions and patrols have since gone up the Fly River, but they brought back no natural history collections and none more than reached the foothills where they reported impassable limestone hills. Until 1927 no white man had ever penetrated the mountains about the head waters of the Fly River, the mightiest river of the southern slopes of New Guinea. Its exact source was unknown.

In 1927-29 the Northwest Patrol was organized by the Papuan government to find the source of the Fly and to cross to the Sepik River. Mr. Karius and Mr. Champion of the Papuan government service, intrusted with this difficult mission, found a way over the limestone hills and were completely successful in their second attempt; they were the first men to cross New Guinea in this area.

The various accounts of these hurried patrols, which earned for Karius the medal of the Royal Geographical Society, are the only descriptions available of the area in which Mr. Archbold's party plans to collect as it follows inland the trail blazed by Karius and Champion.

To the east the nearest collections from the mountains come from the Wharton Range about 450 miles away. To the west no collecting has been done nearer than the Snow Mountains a distance of about 200 miles which are still imperfectly known.

The expedition is going into a practically unknown area. It plans to stay there nine months or more where local assistance from the natives is uncertain and land travel and communication slow and precarious. But with the adoption of the most modern means of air travel and radio to the needs of a well organized and well equipped natural history expedition, it promises to be extremely successful. Besides blazing a trail into new country, the expedition is also adopting a new technique in exploration which will shorten the weeks and months of travel as experienced by the older explorers to hours and days in this new type of exploration of the future.

Astronomy and the Hayden Planetarium

During the month of March the subject of the Planetarium lecture will be "THE SEASONS."

On March 18, 10:45 to 11:00 P.M., there will be given the monthly broadcast of the Hayden Planetarium over Station WABC. This broadcast is entitled "THE DRAMA OF THE SKIES" and is presented by Clyde Fisher, Hans Adamson, and Bob Trout.

Planetarium Special Lectures

The two lectures scheduled for March, in the Second Series of Six Planetarium Special Lectures, are:

March 11—THE MIDNIGHT SUN: THE SKY AT THE NORTH POLE.

March 25—SPRING CONSTELLATIONS OF OUR HOME SKY.

These lectures will be given by Dr. Clyde Fisher, curator of astronomy and The Hayden Planetarium at 6 P. M.

Subscription to the series of six lectures is \$2.50. Admission to any individual lecture may be had only by subscribing to the entire course. The two March lectures are the second and third of the series.

Subscription tickets may be purchased at the Planetarium Ticket Office, or by mail—check made payable to E. Roland Harriman, Treasurer.

Amateur Astronomers Association

At the meeting of the Association on Wednesday, March 4, Mr. Joseph L. Richey, of the American Telephone and Telegraph Company, will speak on "ASTRONOMICAL FACTORS IN RADIO." This lecture will be illustrated with sound motion pictures and lantern slides.

At the meeting of March 18, Mr. Charles H. Coles, Research Bureau of Brooklyn Edison Company, will speak on "PHOTOGRAPHIC EXPERIENCES IN ASTRONOMY," with motion pictures and lantern slides.

These meetings are open to the public and are held at 8:15 P.M. in the Main Auditorium of the American Museum of Natural History.

Astronomical Exhibit

The Astronomical Exhibit, under the auspices of the Amateur Astronomers Association, was open to the public for sixteen days in late January and the beginning of February. During that time almost 15,000 persons visited the exhibit and displayed considerable enthusiasm.

The Foucault Pendulum, which was swinging continually across the floor of the hall, was the center of interest. By its apparent turning across the floor it gave visual proof that the earth is rotating on its axis. A daily demonstration was given of how the craters on the moon may possibly have been formed by the impact of large

meteorites long ago. During this demonstration the lecturer dropped, or threw, marbles and ball-bearings into a soft, flat mass of modeling clay mixed with water. It was found that under the right conditions craters were produced very similar to those now seen on the moon, even including the central peak Meteor Crater in Arizona is believed to have been formed in the same manner.

Another daily demonstration given by members of the Amateur Telescope-Making Class illustrated the method used in grinding telescope mirrors. The process and materials employed are similar to those used to grind the largest telescope mirrors in the world, including the new 200-inch glass which will be installed on Mt. Palomar in California. Also, in many cases were shown mirrors which were made by amateurs, and on the floor of the exhibit were displayed the tubes and mountings in which these mirrors are used. The largest telescope on display was made by Mr. J. McAdams of Hastings, New York, a 12 $\frac{1}{2}$ -inch reflector with a mounting weighing more than 200 pounds and an aluminum tubing.

Many charts, star maps, models of stellar distribution, star boxes, home made sextants, as well as similar products of commercial producers were also displayed. Also many astronomical books, old astronomical instruments, and a replica of Galileo's telescopes were shown.

The growing interest of the public in astronomy was conclusively demonstrated, not only by the interest shown by those attending the exhibit, but also by the large number of individual exhibitors who made it possible.

The Junior Astronomy Club

The ancient astronomers used to reckon the beginning of the year from the March equinox and the Junior Astronomers do likewise this year when their elections fall on the meeting of the twenty-eighth of that month. The present officers have carried the club through its most successful year with the publication of the *Handbook of the Heavens* by McGraw-Hill, and the successful revision and sale of the *Star Explorer*. The speaker for the March 14 meeting is to be selected by competition and will add another speaker to the already large number of Juniors who have qualified to lecture to the club, and to other groups who call upon the club's Lecture Bureau for speakers on astronomical subjects.

American Museum Lectures

CHILDREN'S LECTURES.—During March the free lectures for children of the public schools will be given on Fridays, at 10:30 A. M., as follows:

March 6—THE DUTCH AND THE INDIANS IN EARLY NEW YORK. A. E. Johnson.

March 13—MEXICO. G. L. Pratt.

March 20—THE STORY OF COMMUNICATION. J. R. Saunders.

March 27—ANIMALS, PEOPLES, AND PRODUCTS OF AFRICA. W. R. Smith.

SATURDAY AFTERNOON PROGRAMS.—These motion pictures will be shown at 2:00 P. M.

March 7—ANIMAL BABIES.

March 14—THE WORLD OF PAPER.

March 21—JOURNEYS IN EUROPE.

March 28—OUT WEST.

At 4:00 P. M., on March 21 will be given the first of four informal talks on the Cultural Appreciation of Gems, by Mr. Herbert P. Whitlock. It is entitled GEMS—ANCIENT AND MODERN. The second talk, on March 28, will be on THE ART OF THE LAPIDARY.

CHILDREN OF MEMBERS.—The March lectures for children of members are held Saturday mornings at 10:30 o'clock.

March 14—AFRICAN ADVENTURES WITH WILD ANIMALS. Capt. C. W. R. Knight.

March 28—WILD FLOWERS OF SPRING. Clyde Fisher.

MEMBERS LECTURES.—These lectures are held at 8:15 P. M.

March 12—ANIMALS AND PEOPLES OF NORTHERN BURMA. H. C. Raven.

March 26—IN THE SOUTH SEAS ON THE "ZACA." James P. Chapin.

Visual Education

Mrs. Grace Fisher Ramsey, associate curator of education at the American Museum, will address the Greater New York Safety Conference on March 5 at the Hotel Astor on "Visual Aids for Safety Teaching," giving sources of material that will aid the teacher in safety instruction, the standards by which the value of visual aids may be determined, and why the positive approach should be emphasized.

On March 13 Mrs. Ramsey will speak before the Geography Section of the New York Society for the Study of Experimental Education. Her subject will be "The Teaching of Geographic Relationships with Objective Aids." Her talk will be illustrated with many types of visual material from the American Museum, including miniature habitat groups, lantern slides, photographs, motion picture films, etc.

Lectures by Explorers

The American Museum is inaugurating a series of lectures for the general public, with a view to giving visitors an opportunity to hear from its explorers themselves a personal account of the Museum's important expeditions. The lectures are free and will be given in the auditorium of the Museum on Tuesday evenings at 8:15 o'clock, according to the following schedule:

March 3—BIRD ISLANDS OF PERU: Dr. Robert Cushman Murphy, Curator of Oceanic Birds.

March 17—HUNTING FOSSILS IN CANADA: Dr. Barnum Brown, Curator of Fossil Reptiles.

March 31—DAY AND NIGHT ON DOMINICAN TRAILS: Dr. G. Kingsley Noble, Curator of Herpetology and Experimental Biology.

April 14—GORILLAS AT HOME: Mr. Harry Raven, Associate Curator of Comparative and Human Anatomy.

April 28—DIVING IN CORAL GARDENS: Dr. Roy W. Miner, Curator of Living Invertebrates.

It is considered that this acquaintance with the field work upon which the habitat groups are based will add greatly to the interest of visitors to the exhibition halls.

The Bahaman Coral Reef Group at the American Museum

The Bahaman Coral Reef Group in the Hall of Ocean Life was completed during the latter part of 1935. Since that time the western end of the hall immediately surrounding it has been renovated and protective brass rails installed in front of the group, so that all parts of this two-story exhibit are now completely accessible to visitors for close inspection.

This exhibit, which was designed by Curator Miner, has been in progress for the past twelve years. To obtain material for it, Doctor Miner led five undersea expeditions to the Bahamas. The work has been executed under his direction by Chris Olsen of the modeling staff of the department of living invertebrates, assisted by Bruce C. Brunner and, at various times, by Dr. George H. Childs, Worthington H. Southwick and Herman Mueller, also of the departmental modeling staff. The upper background was painted by Francis Jaques and represents that part of the lagoon at Andros Island in the Bahamas where the studies of the coral barrier reef were made.

Forty tons of coral specimens, hundreds of gorgonia and other creatures of the coral reef, including sponges, crustacea, and fishes, were secured for this exhibit. About eight and one-half tons of steel were utilized in its construction, as well as extensive surfaces of plate glass. The two great sheets of glass protecting the front of the group are among the largest that have been installed in this city.

Many persons have participated in making this group possible. Among those who have taken part in the expeditions or who have coöperated with Doctor Miner in the field, besides Chris Olsen, Dr. George Childs, Herman Mueller, and Francis Jaques of the Museum staff, were J. E. Williamson, who contributed the use of his remarkable submarine tube in 1924 and accompanied the expedition of that year; John H. Phipps, in connection with the expedition of 1926; Hugh L. Matheson, in 1930; and Mr. and Mrs. Roswell Miller, Jr., in 1933. Mrs. Miner and Roy W. Miner, Jr., also accompanied and assisted in various expeditions. Among the supporters of the expeditions, including those who contributed boats, equipment, and other facilities, were the Angelo Heilprin Fund, Ford Forsythe, E. S. Toothe, Junius Spencer Morgan, Clarence L. Hay, Mrs. William Belknap, John S. Phipps, Daniel Bacon, Roswell Miller, Jr., and Edwin C. Moseley.

The Bahaman Government coöperated in the enterprise most effectively, and placed every facility at the Museum's disposal. In this connection, special thanks are due to the Governors of

the Bahamas who have been in office during the course of the work, namely, Sir Harry Cordeaux, Sir Charles Orr, and Sir Bede Clifford, as well as to the late Sir George Gamblin, formerly president of the Governor's Council, and Mr. Elgin Forsythe, Commissioner of Andros.

A group of this monumental character could be brought to completion only with the efficiently organized coöperation of Museum personnel with cordially interested collaborators and the support of generous benefactors.

Gorillas

"In Quest of Gorillas," Prof. William K. Gregory's record of the Columbia University-American Museum expedition across Africa is appearing serially in the *Scientific Monthly*. The first chapter was published in November, 1935, and succeeding parts will run throughout the year. The party included Mr. H. C. Raven, leader of the expedition, Prof. J. H. McGregor, Dr. E. T. Engle, and Professor Gregory.

Visiting European Museums

Dr. Robert T. Hatt, director of the Cranbrook Institute of Science at Bloomfield Hills, Michigan, and Mrs. Hatt (Marcelle Roigneau) sailed from New York January 31 on a short trip to England, Germany, and France. They will visit all the larger museums of Germany in the interest of Cranbrook Institute, returning to this country about the middle of March.

Exhibits in Memorial Hall

A committee of the education department staff of the American Museum has been appointed to take charge of the placing of timely and temporary exhibitions in Memorial Hall. The purpose of these exhibits is to bring to the attention of the Members and the public the latest additions to the collections, new exhibits for the halls, and other features pertaining to the Museum's work. For examination during January a model of the South Polar Cap was displayed, showing the route of Lincoln Ellsworth's flight across Antarctica, while near it were displayed some of the specimens collected on previous expeditions by Mr. Ellsworth and presented to the Museum.

Another exhibit was the reproduction of a monolith in the form of the human figure from Easter Island, collected by Dr. Harry L. Shapiro as a member of the Templeton Crocker Expedition to the South Seas.

In February an exhibit was made of implements collected from tribes in the center of New Guinea and presented to the Museum by Mr. M. J. Leahy. Another February exhibit was two mounted specimens of the giant panda, collected and presented by Dean Sage, Jr.

The March program will include the display of the model of the Coral Reef Group showing what the real Coral Reef Group in the Hall of Ocean Life is like.

These temporary exhibits are displayed for about two weeks each.

On November 26 at a meeting of the Fellows of the American Geographical Society, the Charles P. Daly Medal was presented to Dr. Roy Chapman Andrews, director of the American Museum of Natural History. The medal was presented by Mr. Roland Redmond, president of the American Geographical Society. The citation is as follows:

Doctor Andrews has said of himself, "I was born to be an explorer. There never was any decision to make. I couldn't do anything else and be happy." In satisfying his own instinct Doctor Andrews has contributed vastly to human knowledge. By his expeditions to Central Asia he has demonstrated that the day of the lone explorer, who merely gathered impressions by passing through an unknown country, is over. An expedition carefully planned and intelligently equipped to study in the field all the various aspects of the unknown, to gather collections of importance and to transport them to the laboratory, the workshop and the exhibition halls of civilization, is now the order of the day. Due largely to his work a new standard of exploration has been established.

His name is indissolubly linked with a vast region. Men in all walks of life associate his name with Mongolia much as they associate the name of the late Colonel Lawrence with Arabia. Thanks largely to Doctor Andrews' work the wild plains and wind-swept uplands of that vast country are no longer among the least known parts of the earth's surface.

To Doctor Andrews—Andrews of Mongolia—it is my privilege to present, on behalf of the American Geographical Society, the Charles P. Daly Medal, awarded from time to time by the Society for valuable or distinguished geographical services or labors.

Among the other recipients of the Daly Medal are Robert E. Peary, Roald Amundsen, Vilhjalmur Stefansson, Sir Francis Younghusband, Knud Rasmussen, and Captain Robert A. Bartlett.

Yellow Fever

Raymond M. Gilmore, who collected specimens for the department of mammals of the American Museum at the Harriman Ranch in Idaho this past summer, has been given a special assignment by the International Health Division of the Rockefeller Foundation to study and collect monkeys and other wildlife of South America in connection with the work of the Foundation on yellow fever. The American Museum has large collections of South American mammals and, more specifically, important series of New World monkeys, so that it enjoys a community of interest with the Foundation in the results of Mr. Gilmore's work in the field. When sufficient material and data have been assembled, Mr. Gilmore will be offered the facilities of the mammal department in making his identifications, comparing with the material in the department, and in following out any of the biological clues pertinent to the yellow fever problem. It is hoped that such mammal material collected

by Mr. Gilmore as will not be needed on permanent deposit as reference collections with the Foundation will eventually find its way into the collection of the Museum.

The plans for the work of Mr. Gilmore are of

special interest to the Museum because of the possibility of a close coöperation between the student of life histories and of biological data and the doctors leading an attack upon a menace to human life, namely, yellow fever.—H. E. ANTHONY.

RECENTLY ELECTED MEMBERS

A REPORT from the membership department lists the following persons who have been elected members of the American Museum:

Associate Founder

Mr. Templeton Crocker

Patrons

Mrs. H. P. Davison

Messrs. Max C. Fleischmann, Frederick M. Warburg.

Fellows

Messrs. William Bingham, 2d., William C. Wood.

Life Member

Mr. William S. Paley

Sustaining Member

Mrs. John J. White, Sr.

Annual Members

Mesdames Charles Brickell, Eva S. Browning, Moses H. Cone, Willard I. Emerson, Oliver D. Filley, W. A. Graham, Walter Huber, Lizzie F. Jones, Milton W. King, Christopher La Farge, Richard L. Livermore, Anne-Marie MacDonald, D. A. Moulton, J. Prince, Rita Sengstaken, Charles W. Stapleton.

Misses Elizabeth F. Broden, Ellen M. Bywater, Grace G. Engleman, Anna Hollwegs, Edith G. Marshall, Bertha A. Moat, Gertrude Moodey, Audrey F. Moritz, Rachel Hopper Powell, Maria F. Schuette, Helen Tompkins, Susan W. Underwood.

Doctors Philip G. Cole, Daniel Crosby, Ralph E. De Lury, George Draper, James Alexander Lyon, Frank R. Ober, James Ralph Scott.

Professor Earle B. Phelps

Messrs. Edward A. Bell, John Benson, Harry Blickstein, F. C. Bolles, Jr., N. H. Busey, Jr., H. C. Carpenter, Thomas I. Dowling, Martin F. Ernst, Fred W. Fuhrmann, James B. Gould, Andrew P. Hachtmann, George Watts Hill, W. Knowlton Hoag, George W. Hubbell, Eugene W. Kettering, William H. Kilpatrick, J. Frederick Larson, James McEvoy, Edward Q. McVitty, Henry W. Muller, George Pert, Auguste Richard, Otto Rucker, Whitney H. Shepardson, Barry C. Smith, Alonzo Williams.

Associate Members

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Raymond Coppinger, H. D. Cornelius, E. H. Denicke, Lewis B. Franklin, Henry G. Fritsche, Charles W. Hinckley, Milton J. Hoffer, Marie Kingsbury, Frank S. Lloyd, A. M. Loeb, John Lushear, R. McCarthy, H. B. McFarland, Mary Nelson, G. E. Rarig, M. N. Schnur, Clarence Southerland, Rush Sturges, Edith Tallmadge, Luella M. Wiers, Frederick H. Wiggin.

Mother Birchman

Misses Grace W. Andrews, Mamie G. Armsby, Marion Avery, Winifred Bartlett, Jane Colburn Belcher, Lulu N. Booth, Fern Bradford, Edith S. Brodney, Jemima O. Brown, Caroline Bullock, Gertrude Cahill, Elsie M. Calder, Mary H. Davis, Marjorie Dickieson, Constance Everett, Lilla A. Frohock, Gratia Goller, Diane Gould, Elsa C. Haupt, Lorena Hindes, Naomi Howells, Janet P. Jamieson, Elsie Kaisinger, R. Kapp, Pearl Keller, Helen Kerr, Sue A. M. Konn, Stella N. Krieger, Marjorie M. Lamm, Bertha M. Leathers, Elizabeth Morley, Neilsine Neilsen, Etheldreda L. Norris, Dorothy Pease, Marjorie Pease, Mame Priest, Caroline S. Rawlins, Olive O. Robinson, Elise E. Ruffini, Florence Sebastian, Florence B. Shawkey, Agnes Snyder, Jennie Stott, Adelene Sylvester, Clara Mae Taylor, Elizabeth W. White, Sarah O. Whitlock, Lenore Wilson, Maud May Wood.

Reverends A. R. Brown, Gerhard Bunge, Bradford Young.

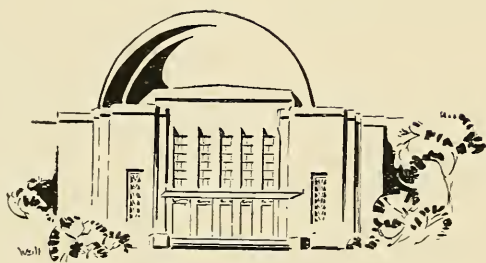
Lieutenant Morton D. Adams

Doctors Thaddeus Hoyt Ames, Harry E. Bacon, Eleanor S. Bancroft, William Bates, William A. Bennett, Edward W. Briggs, B. J. Brown, W. W. Bunnell, Sylvester, Cherniak, Eugene M. Clifford, Frank E. Collins, Henry N. Costello, John A. Doering, Wm. Epstein, Lucy G. Forrer, B. A. Fuld, Ruth Gilbert, Charles H. Green, Charles H. Greene, James E. F. Henry, Robert J. Hill, Donald H. Hooker, Ralph L. Jacobs, Irving W. Losee, Donald F. Munro, Frank D. Myers, George W. Papen, Wm. H. Perry, A. D. Pierce, Max Pollock, F. C. Rodgers, W. Vernon Ryder, P. V. Senegas, Hermann B. F. Seyfarth, George L. Shattuck, Leslie A. Spelman, George F. Stoney, Atle B. Suhrland, C. L. Thenebe, Louisa Paine Tingley, Charles H. Tozier, Everett C. Turner, Henry E. Utter, F. A. Walsh, Wm. A. Weinreb, Dwight E. Weir, R. W. Whitcomb, Norman C. Yarian.

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Reviews of New Books

Aquaria, Astronomy, Birds, Insects, Ferns, Mankind

1001 QUESTIONS ANSWERED ABOUT YOUR AQUARIUM. By Ida M. Mellen and Robert J. Lanier. Dodd, Meade & Co., New York.

THE recent growth in popular interest in aquarium fishes has been responsible for the appearance of an array of new books. Although the subject matter in these various aquarium books is much the same, the methods of presentation, the illustrations, and the number of species considered vary from book to book. The most recent addition to this group of aquarium books has been produced by Miss Ida Mellen, formerly of the New York Aquarium, and Mr. Robert Lanier, of the Steinhart Aquarium, of San Francisco. Doubtlessly, these two workers in the course of their professional duties, have had many occasions to answer questions in regard to aquaria under their supervision. The book they have just published, however, is far more than a set of answers to the most frequent questions raised by visitors to a public aquarium. It is actually a complete handbook, with chapters on fresh-water aquaria; tropical toy fishes; gold fishes; salt-water aquaria; outdoor aquaria, and terraria. It also includes hints on the care of diseases of fishes; methods of regulating the pH; ways to catch and ship fish, as well as various other items of interest to the keeper of fishes, frogs, turtles, and snakes.

In order to hold to a uniform plan of raising questions and then answering them, the authors have found it necessary to split up many simple subjects into small sections. Questions 395 to 400 run, for example—What is the disposition of *Rivulus*? What food is necessary for *Rivulus*? What water temperature is necessary? What size does *Rivulus* attain? How are the sexes distinguished? What are the characteristics of *Rivulus*? Such minute divisions of a simple subject make the reading difficult. The chapters dealing with terraria and native fishes are very brief. But the bibliography includes 236 titles which may tempt the student of aquaria to dig deeper. The book is enhanced by many illustrations, several of them in color.

In brief, the book in spite of its cumbersome method of presentation will remain a useful addition to the recent series of books which the student of aquaria should have near at hand.—G. K. N.

BIRDS AND THE SEA. By Frances Pitt. Longmans, Green & Co. London-New York-Toronto. \$2.50.

IN this series of essays, Miss Pitt has given us some animated sketches of several "wild goose chases," not only after wild geese of various sorts, but also in search of gannets and shearwaters, guillemots, puffins, phalaropes, loons, and numerous other species of birds (even including seals and meadow mice) which inhabit the coasts and islets of the British Isles. The author is a keen observer and a pleasing writer, and her descriptions of the habits and activities of the different species she has encountered on her excursions, not to overlook her own activities, make interesting reading.

Sometimes her statements are too sweeping when she is quoting from outside sources. Thus, one might query the note that the great northern diver stays on salt water, even in the breeding season, which is not unqualifiedly true of this species throughout its range; or that "it has been proved that birds subjected to artificial illumination will come into breeding condition (with consequent desire to migrate) in mid-winter,"—a statement that also needs some modification to escape all burden of error. Nevertheless, such errors are not frequent, and do not discredit the accuracy of the author's personal observations on the wild life she has studied in the field. Whether on the sandbanks of The Wash, the Cumberland coast, the Welsh Islands of Ramsey, Grassholm, Skomer, and Skokholm, the Farne Islands, or the Orkneys, or on the wild Norwegian lake where one scene is laid, she found always something of interest to record and something about which to speculate. This is no technical dissertation nor is it concerned with debatable problems, but it gives a running account of enjoyable days and nights afield and the lover of nature will find pleasure in the reading. Numerous excellent illustrations from photographs, presumably by the author, illustrate the book.—J. T. Z.

FERNS OF THE VICINITY OF NEW YORK. By John Kunkel Small, 285 pp., The Science Press, 1935.

FERN lovers will welcome this manual of their favorite plants,—ferns and fern allies,—of the New York region, written by one of America's highest authorities in systematic botany. For many

years the author had charge of the herbariums of the New York Botanical Garden, but this important position gives no indication of his indefatigable work for more than a third of a century as a field naturalist.

This little volume, it seems to the reviewer, leaves nothing to be desired in the way of a handbook for use in learning to know this group of plants. First, it is complete, covering all of Connecticut and New Jersey, eastern Pennsylvania, and southeastern New York. The parts of New England and New York not covered add but a few rare species to the eighty-five treated here, and those of Pennsylvania none. Second, it is popular, that is, usable by the amateur; and yet it goes beyond the usual information of elementary guides.

The full-page illustrations, one for each species, are the feature that make it useful for beginners in fern study and for those who do not like technical keys. The illustrations showing the fruit-dots (the sori and indusia), and the venation were very carefully drawn under magnification. We believe it is safe to say that the line drawings in Doctor Small's book are the best figures of our local ferns ever published. In fact, they are so clearly drawn that the fern specimen may be identified by simple visual comparison with the drawings.

This attractive manual should find wide use among Boy Scouts, Girl Scouts, Camp-fire Girls, Woodcrafters, and other beginners in fern study.

—CLYDE FISHER.

OUR ENEMY THE TERMITE. By *Thomas Elliott Snyder*. Comstock Publishing Co., Inc., Ithaca, N. Y. 196 pp.; 56 figures. Price, \$3.00.

POSSIBLY no other insects have furnished the basis for so great and so widespread human frauds as have our native termites. Doctor Snyder, who for years has been the federal government's authority on these interesting creatures, describes the situation very mildly in saying,

"Recently in the vicinity of New York City, and earlier in other localities, the normal spring appearance of winged forms of termites in or about buildings was used by unscrupulous agents to sell useless materials or perform expensive and ineffective treatments to buildings. Salesmen have been exaggerating the danger from termites in an effort to sell treatments, many of which have little or no merit, but which they picture as absolutely necessary to prevent the collapse within a short time of buildings invaded or under alleged danger of being invaded by termites. Home owners should be aware of overdrawn and alarming reports of injury to buildings by termites. In particular they should be wary when exaggerated statements of this kind form a part of the 'sales talk' for a termite treatment."

In this book Doctor Snyder has brought together a great amount of general information about termites. He tells of their distribution in time and space, of their "social" life superficially so like that of ants, of their "guests" and their

parasites, and of still other things that make termites intensely interesting to biologists. While these are not told with the literary charm of a Maeterlinck, the facts are there. Furthermore, this book is important to Americans because it exposes the termite "racket," shows the uselessness of various nostrums, and points out how care in construction of our buildings prevents trouble from termites, at least in northwestern United States at present. If you have become termite-conscious, buy a copy of this book. The "enemy," when properly understood, is not always dangerous, but ignorance may be expensive.—F. E. LUTZ.

INSECT ENEMIES OF SHADE TREES. By *Glenn W. Herrick*. Published by *The Comstock Publishing Co., Ithaca, N. Y.* \$5.00.

THERE has long been a demand for the kind of book that Professor Herrick has given us—a chronicle of the insects attacking shade trees and detailed instructions for their control. The value of a work of this kind depends upon several factors, chief of which is the ability of the reader to discover the name of the pest attacking his trees. Once this has been found, the next step is the determination of proper control measures and their application. If we presume that the reader is acquainted with the names of the trees ornamenting his property, we can promise that there will be little difficulty in recognizing the pest and applying the necessary control measures. Professor Herrick has so arranged his text that a chapter is given for each of the important shade trees of the United States, the insects attacking each are discussed and control measures outlined. The principal insect pests are described in sufficient detail so that they may be readily recognized, particularly if recourse is had to the many wonderful illustrations. It is these latter that particularly incite our admiration for this book. We have seen very few texts on subjects dealing with economic entomology so thoroughly illustrated, and none in which the entire ensemble has been of such a high standard.

We have often wondered about the value of a shade tree. Of course, it is not possible to give a definite value because so many things enter into the picture. But, disregarding any sentimental valuation, we find that a ten-inch elm on an ordinary residential lot having a value of \$20 a front foot would be worth \$200, while the same tree on the same frontage at \$5 a front foot would be worth only \$50. In shade value and popularity the American elm is placed at the top of the list for the eastern United States, while, the author points out, the poplar might conceivably be placed in the position of honor on our prairies. Certain trees are best suited to certain conditions. The chapter on materials and apparatus used in insect control is thorough and one on the treatment of weakened trees covers this important phase of tree health. The main chapters are arranged alphabetically according to common names of the trees so that they may be quickly picked out without recourse to the index. Of all the shade trees

the gingko stands by itself, being almost free of insect enemies and never, apparently, subject to noticeable injury.

To a well-rounded treatise on the main pests of the larger shade trees there is added a chapter on enemies of smaller trees and shrubs, enemies of evergreens other than pines and miscellaneous pests attacking not only trees but rustic wood-work. The only vertebrates causing injury to trees are squirrels. "Usually there is not much to be done. Often the squirrels are protected by law and in any case one does not wish to shoot them. Sometimes a supply of food can be furnished when the animals are actually suffering for want of it." This is one method of control for these usually welcome animals. A more ingenious one is given.

We wish to personally compliment Professor Herrick upon his fine contribution to the scientific knowledge of the enemies of our most valuable trees and upon the clear, concise manner in which he has dealt with a difficult subject. *Insect Enemies of Shade Trees* should find a place on the shelves of every one deriving pleasure from the grace and beauty that the trees add to our American homes.—C. H. CURRAN.

MANCHURIA, CRADLE OF CONFLICT. By *Owen Lattimore*. Revised edition. Macmillan Co., N. Y., 1935. 343 pp. \$3.00.

TO a large proportion of western observers Manchuria, or in its newer guise Manchuokuo, has become symbolic of new forces reshaping the destinies of the East. To the average layman Manchuria merely represents a vague province once loosely allied to, but now severed from China, and recently established under the protection of Japan.

The first of these views is neither accurate nor historically just. The second is superficial. In *Manchuria, Cradle of Conflict*, Mr. Lattimore has rendered a valuable service by his careful orientation of Manchuria. He has analyzed the geographic, the historical, and the ethno-cultural forces that have been operating for centuries. And from these neglected elements he has extracted a new and convincing concept of Manchurian history. The problems associated with Manchuria are not new. On the contrary, they are ancient. The recent events that have transpired in Manchuria are merely new expressions of age-old conflicts. The modern actors in the drama play traditional rôles.

The anthropological point of view in this book illustrates the great contribution that such studies can make to the proper understanding of modern conditions.—H. L. S.

THE HILL BHUIYAS OF ORISSA. By *Sarat Chandra Roy, M.A.* "Man in India" Office, Ranchi, India. 1935. 8 rupees.

THE Hill Bhuiyas of Orissa are a primitive, rather negroid people living in the hills of Central India. Mr. Roy presents in this account an ethnological description of them, together with some comparative notes on neighboring groups.

An appendix contains measurements of stature and of the head and face of one hundred adult male subjects.—H. L. S.

NEW BOOKS ON ASTRONOMY.

DURING this mid-winter season a number of very excellent new works on astronomy have appeared, covering several phases of the science, popular and scientific. It is proposed that several be reviewed later in these columns. They are on exhibition in the cases of new publications on astronomy, in the Planetarium. Among them are:

Consider the Heavens, by Forest Ray Moulton; an outstanding book—brilliant and fascinating—by a world-famous astronomer and one of the co-authors of the planetesimal hypothesis of the origin of the solar system.

Worlds Without End, by H. Spencer Jones, Astronomer Royal, of the Greenwich Observatory, England, and author of one of the leading texts on astronomy. The above two are popular:

Following are two books in the form of texts: *Highlights of Astronomy*, by Walter Bartky, associate professor of astronomy, University of Chicago; a new book, very modernistic in design, and used as a college text; *Astronomy*, the third edition of the standard textbook by Prof. John C. Duncan, Wellesley College; it contains additions and new material.

Other notable publications are several specialized books: *Eclipses of the Sun*, fourth edition, by Prof. S. A. Mitchell, well-known authority on this subject, who is keeping this valuable reference book up to date; *The Solar System and Its Origin*, by Prof. Henry Norris Russell of Princeton University, a technical discussion of the dynamic, physical, and chemical properties of our planetary system, and its theories of origin; *The Binary Stars*, a very technical treatise by Dr. Robt. G. Aitkin, Lick Observatory, and a leading authority on double stars; *Stars and Telescopes*, by Dr. James Stokley of the Fels Planetarium. In this work much of the history of astronomers and their instruments is taken up, forming delightful reading.

Two foreign books reserve mention: *Il Sole*, in Italian by Giorgi Abetti of the observatory at Arcetri, Italy. Professor Abetti is a world authority on this subject, the sun; *Lunettes et Télescopes*, in French, by André Danjon, director of the Observatory of Strasbourg, and André Couder, astronomer of the Observatory of Paris. This last work of xvi + 715 pages is a very technical and useful guide for practical astronomers who are particularly interested in telescopes [refractors and reflectors]. It is well illustrated, covers the optics of the telescope, invention and history of the different types, mountings, auxiliary apparatus, the construction, testing and use of the instruments, and has detailed lists of the great telescopes in use. The book does not overlap on the grounds of the two recent American books on the subject, Doctor Stokley's book mentioned above, and the excellent volume *Men, Mirrors and Stars* by G. Edward Pendray, with its absorbing story of great telescope men.—HUGH S. RICE.

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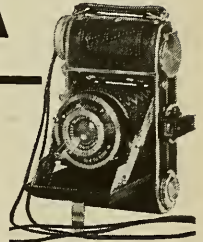
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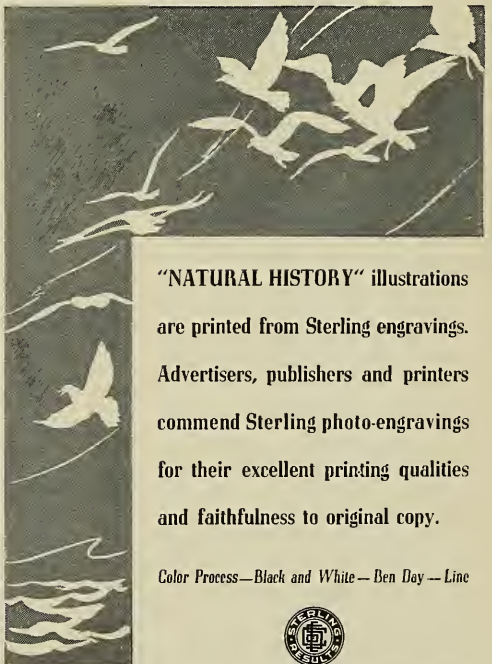
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A PRIMITIVE HOME IN RAPA

A Polynesian house, well built of native materials from palms, bamboos, and screw-pine leaves, is a joy to the eye.

All too many, nowadays, are made of sawn lumber, often imported. A grass hut of this simple type is a rarity

Through Southern Polynesia

Exploring some rarely visited islands of the South Seas, including Pitcairn and Easter—The second stage of the Templeton Crocker Expedition

By JAMES P. CHAPIN

*Associate Curator, Continental Old World Birds,
American Museum*

TEN days the "Zaca" had lain alongside the busy wharf at Papeete, the "hub" of French Oceania. Schooners arrived from the Tuamotus with cargoes of copra. Smaller fishing boats brought their abundant catch to market. A transpacific steamer discharged a cargo of lumber.

The "Zaca" was being prepared for the long voyage of five thousand miles to Valparaiso. It was now November, and we could expect the best weather of the year in that breezy belt of ocean, near the tropic of Capricorn, marking the southern fringe of Polynesia. Frequent easterly winds were certain to delay our progress, if nothing more, as we cruised through the Austral Islands and on to Rapa, Pitcairn, and Easter Island.

Earth's watery half

Take a globe and examine the half that includes the Pacific Ocean. You will be impressed by the small proportion of land visible on that side. Western North America and Australia are on its opposite fringes, and Tahiti is a tiny speck in the middle of a vast area dotted with many groups of islands, often separated by hundreds of miles of fickle ocean. If the first navigator in the Mediterranean had a heart of triple bronze, what shall we say of the brave Polynesians in canoes who discovered and colonized the majority of these Pacific islands? Starting from somewhere in Asia without compass or chart, they reached New

Zealand and Easter Island. In his comfortable "Zaca," the last word in schooner yachts, Mr. Crocker was now taking us in the wake of some of the ancient Polynesian explorers.

Off for Rimitara

At daybreak on November 23 we sailed southward from Papeete for Rimitara in the Austral Islands, a group sometimes also called the Tubuai Islands. For hours we watched the misty heights of Tahiti, where Orohena Peak, rising 7321 feet and seldom ascended by man, gave us an occasional glimpse until noon. The Austral Islands are mainly composed of volcanic rock, with coral reefs about them, sometimes hilly or even mountainous, yet not large. We were to visit three of the five islands, mainly for the study of their human inhabitants.

The voyage to Rimitara took only fifty hours. There are no gulls on these waters. A few shearwaters (*Puffinus*) or gadfly petrels (*Pterodroma*), red-tailed tropic birds (*Phaethon rubricaudus*), and boobies (*Sula*) are the birds usually seen. The boobies, like our northern gannet, have stream-lined bodies, almost cigar-shaped, propelled by energetic pointed wings, and dive expertly. The tropic birds have two long, red tail-quills, so slender as to be all but invisible against the sky. They seem inquisitive, often flying up from astern to look over the ship and squawk. The shearwaters and petrels keep more aloof, but their scaling flight is perfectly distinctive.

Close to land other sea birds appear. Approaching Rimitara, we were met as usual by

blackish-brown noddies (*Anous stolidus*), and graceful, pure white terns (*Gygis alba*), two of the commonest species in all the islands of this region.

Rimitara is a small, low island, formed partly by volcanism, partly by the upraising of coral rock. Landing is more difficult than it looks. From one apparently smooth beach two men came out in a canoe to warn us off. We should land at a spot where there seemed to be no beach at all. There we jumped out on the reef and walked up through great *Casuarina* trees, suggestive of pines, to a road leading to one of the three principal villages.

Austral Sabbath

It was Sunday, and nearly everyone was in church, a white stone building dated 1857. Christianity has taken firm root here, a large church dominates every village of any size, and the minister is usually a native. My day was spent largely in the woods, where there were but two resident land birds, a grayish warbler (*Conopoderas vaughani rimitaræ*) and a beautiful little red-breasted lory (*Vini kuhli*).

Out on the shore a few gray reef herons waded and fished. I know that if my work as a zoölogist had been there, I should have been so busy as to regret leaving. It was Mr. Crocker who always devoted a fruitful part of his time to collecting algæ, invertebrates, and fish from the tide pools.

A run of one night took us to Rurutu, the next island to the west, much larger and higher. One of its eminences, Mt. Manureva, rises to nearly 1300 feet. There are coconut groves and some woods with trees of relatively few kinds, and its hills are often grown over with ferns and grasses.

Some 1500 natives dwell here, as well as five whites and a few Chinese storekeepers. Avera Bay, our first anchorage, is partly filled by a broad, fringing reef. Through it runs a deep pass, so that the islanders are able to bring in the schooner they own, and moor it in a small basin. The village was not at all primitive. Here, as in Tahiti, mynahs (*Acridotheres tristis*) had been introduced, and there were no native land birds. Some of the cliffs attracted white-tailed tropic birds (*Phæthron lepturus*), whose long streamers are so broad they can be seen from afar.

The next morning we rounded the island and visited Moerai, where dwelt the French police officer, his wife, and three Americans. Father Olivier, Breton missionary on Tubuai for the past fourteen years, was also here for a visit. With him and the Seabrooks, a studious couple, my time passed all too rapidly.

The village school under the charge of a Tahitian schoolma'am and a male *moniteur*, held 120 youngsters. All rose at once and said "*Bonjour, Monsieur*" as I looked in. They learn in French but seem to forget all too much of that language after they leave school.

During our two evenings off Moerai we were favored with the most memorable fishing scene I have ever known. After nightfall, a half dozen large rowboats would put out through the reef to row back and forth, catching flying fish. The sport was illuminated by a huge torch of dried coconut leaves held aloft in the bow of each boat. Its flare, designed to attract the fish, showed us the oarsmen, the helmsman, and two or three men holding nets at the alert. One of them leaned out over the bow, his movements showing how frequently the fish rose to fly toward the blaze. Each torch burned about five minutes, then a new one was lighted. Our own submerged light attracted only a half dozen of the same fish, most of which escaped. This time the Polynesian method won.

Thanksgiving dinner

Passing just within sight of Tubuai Island, we continued toward Raivavae. On Thanksgiving Day the sea was so rough that Mr. Crocker's splendid dinner was eaten with some misgivings. Only a "dare" prompted a second helping of turkey. Another equally hard day followed and the next morning Raivavae showed the tops of its mountains, looking like separate islets. Finally they all joined up, and at four in the afternoon we dropped anchor outside a barrier reef that encircles the whole island. It is barely five miles long, yet rises in a narrow ridge with several peaks to 1434 feet.

About the vertical cliffs along this ridge both kinds of tropic birds were flying. There were more red-tails than white-tails. A half dozen small gray noddies (*Procelsterna albivitta*) seemed also to nest there. The talus at the base of the cliffs was wooded, but the

grassy higher levels on Raivavae support a few hundred goats of varied colors.

We soon acquired a native guide; and with Toshio Asaeda, our photographer, and two sailors, I spent a day following the crest of the high ridge. There was a narrow trail, worn rather by goats than by men, with many ups and downs. We heard a wild rooster crow, and later a hen clucking excitedly. There were guava bushes and orange trees up here, candle-nut trees and gnarled *Metrosideros* trees with bunches of small red flowers.

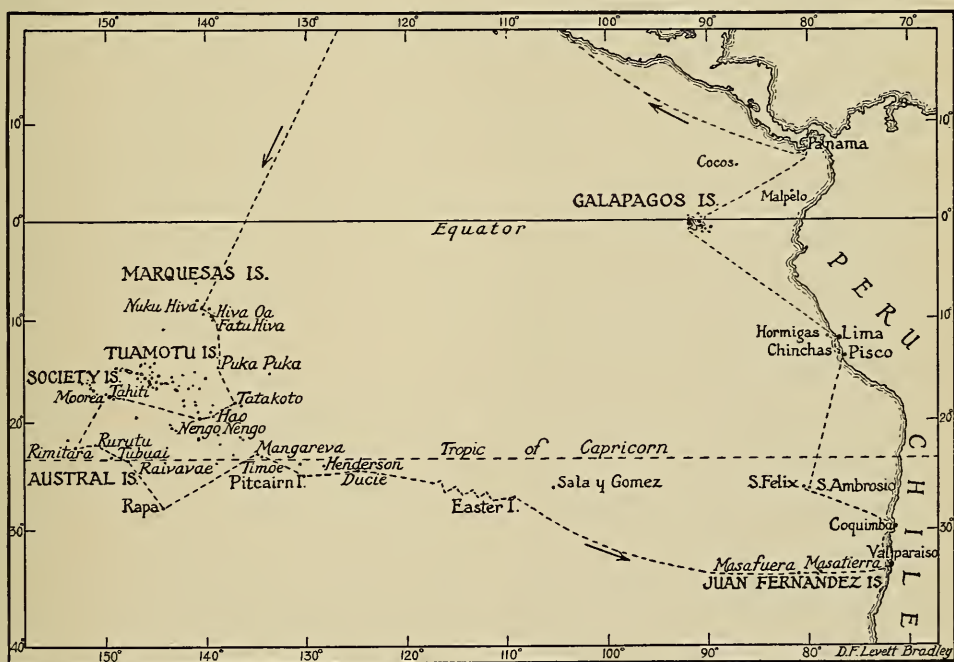
A little after noon we stood on the summit of Mt. Hiro, highest of them all, with a thrilling view over the whole island, its encircling reef, and several palm-covered widenings of the reef. Some shallow parts of the lagoon were white, with coral sand beneath. Other stretches were vividly green or blue-green, and the water over large patches of live coral dull dark blue.

There were no mynahs on this island, nor any indigenous land birds. Along the road-sides were an unusual number of the small lizards, brown with brassy stripes, to be seen on nearly every island.

Sailing from Raivavae, we had a good view of the wreck of a large schooner, high on the reef. This was the "Maréchal Foch," originally Zane Grey's "Fisherman," but later sold for commercial use. On her first visit to Raivavae she met her doom.

Rapa is sometimes included among the Australs, though lying much farther south, in latitude 27° S., about 320 miles from Raivavae. We were now going to a relatively cool island well off all ordinary courses. On the way, as usual, we watched for sea birds, a pursuit in which my friend Jaques is expert. Field-glass bird-study in the Pacific is no simple matter. The shearwaters and gadfly petrels in particular are a never ending puzzle. These two groups are easily confused, their flight is similar and they seldom come close. Many are alike in their gray, brown, and white coloration, while a blackish bird may belong to either genus, or may be only a dark color-phase. They wander far from their home islands, and many a doubtful identification is inevitable.

The morning of the third day showed us the northwest corner of Rapa, an island only



THE LONG ROUTE OF THE YACHT "ZACA"

The Templeton Crocker Expedition sailed nearly 14,000 miles in the Pacific Ocean. The portion discussed in the present article lies be-

tween Rimitara in the Austral Islands and Easter Island; a region very seldom visited by naturalists

five miles long and four wide, deeply cut by bays, and eroded to a jumble of sharp peaks. The outer coast has many promontories ending in vertical cliffs. The slopes elsewhere seemed green and grassy, with a few trees but no palms. The first birds seen were a flock of fifty gray noddies hovering over the water, surprisingly like small petrels. A few white terns, common noddies, and red-tailed tropic birds soon appeared.

Going around to the easterly side, we waited off Ahurei Bay until an elderly native pilot was paddled out in his boat. This bay goes far into the middle of the island, but its inner half is very shallow, with patches of growing coral. No reef encircles the island. On the shores of the bay grow a few coconut palms, but they do not prosper.

We found most of the people considerably browner than the average Polynesian, as a result—it is said—of the liberation of eighteen New Hebrides slaves nearly a century ago. Pure-blooded Rapans have become rare. Their houses were all more primitive, and regrettably dirtier than in the islands to the north.

Not enough men

The young men of Rapa are said to be so attracted by sailor-life that the stay-at-homes are always outnumbered by the women. In the little village of Ahurei there were forty marriageable women still unattached. So at least I was told by the two Frenchmen we found living there. Other settlers were an Australian, a Canadian, and two Japanese.

Horses, cows, and goats thrive on the island, European vegetables grow well, and the most abundant food plant was taro, cultivated in flooded fields with dikes. Many bananas are raised, and coffee for export to Tahiti. Much of the country visible from the bay was grassy but we were assured that there was fine rain forest on some of the higher mountains.

My first desire was to get up in the hills, and it was well rewarded. Looking down beyond the first ridge, I gazed into a well-watered valley with thick, verdant woods in its right half. From the taro fields near Hiri Bay women were carrying heavy bundles up the winding trail back to the village.

Farther along this ridge, still higher, there was one of the old native forts, of which we

had already noticed eight or nine, always on hilltops. A visit was paid to this one, a high terrace or platform, roughly triangular and about a hundred yards long, surmounted by a round tower some thirty feet high. Largely of earth, it had retaining walls of stones where needed. They must have been a quarrelsome people who built so many strongholds on so small an island.

From the ridge we could look down upon the gaudily colored fruit pigeons (*Ptilinopus huttoni*) flying from tree to tree, and hear them cooing. But climbing up or down this steep wooded slope, breaking a way through the ferny undergrowth, was hard work. The pigeons easily kept out of our way. The other birds that came flying over were the usual terns and tropic birds, with an occasional petrel (*Pterodroma neglecta*). There were no warblers on Rapa, and the large brown cuckoo (*Urodynamis taitensis*) that visits most of these islands between March and September had left for its breeding grounds in New Zealand.

While the cuckoos are away in the south, other migrants come from still farther away in the north. The wandering tattler, bristle-thighed curlew, and golden plover all nest in the region of Alaska. What navigators they must be to locate their winter resorts with such accuracy and regularity!

In marshy spots in the lowlands there were small dusky rails (*Porzana tabuensis*) and a fair number of brown wild ducks (*Anas superciliosa*). Though widely distributed in Polynesia, this duck had always eluded us elsewhere.

Interesting plants

While Rapa had not a great many kinds of birds, it delighted me with its variety of plants. The general uniformity of the flora on the other volcanic islands was suddenly broken here. Many old acquaintances like the "purau" (*Hibiscus tiliaceus*), candlenut tree (*Aleurites moluccana*), and "ti" plant (*Cordyline fruticosa*) were here, and in addition a great many plants I had never seen before. One was a *Freycinetia*, like a screw pine (*Pandanus*) but slenderer. Amid its spiky leaves were flowers encased in fleshy red bracts, which were eaten avidly by the natives. Maybe they contained vitamins, to me the taste was not tempting.

A blueberry bush (*Vaccinium rapae*) was a surprise. The tree ferns always delighted me. I would have found many rarities if I had had time to go farther inland and higher. All this suggested a possible connection in the distant past with some land toward the southwest.

Our three busy days on Rapa were not enough for a trip to Perahu, the highest peak, reaching 2077 feet. Early on the fourth day our native pilot climbed down into his outrigger canoe and we were off for Mangareva, in warmer waters.

The Gambier Islands, of which Mangareva is the largest, lie off the southeast extremity of the Tuamotu Archipelago, just within the tropic. They are a small group of about ten volcanic islands, with a great coral reef enclosing them on three sides. Inside it are dangerous beds of corals, and large pearl oysters abound.

Mangareva's great church

We entered this lagoon too late to reach Rikitea, the shady village where the French Administrator resides, and anchored off Mount Duff, a striking peak on the south corner of Mangareva. At its base stands a small building of ecclesiastic form, the tomb of old King Maputeoa. Only after we rounded a headland the next morning could we see Rikitea and its enormous white church, almost a cathedral. On the stone pier we were met by the Administrator, Monsieur Tondon, and his radio officer. The Administrator had practised law for twenty years in China, where he had known our old friend and colleague, Dr. Walter Granger. Our welcome here was naturally most cordial.

The great church at Mangareva was about 100 feet long, built of stone and roofed with red tiles from France. The altar decorations were of mother-of-pearl, and inside the main door hung a painting by Eskridge, author of a book about Mangareva. Although a Protestant mission ship first reached the island and named Mount Duff, it was Father Laval coming from Chile in 1834, who converted King Maputeoa with his people. Then began the stupendous enterprise in masonry. Besides churches, he constructed convents, schools, storehouse, a jail for the mission, and a palace for the king. When the king died, he was laid in a truly royal sepulchre.

Sadly enough, the population of the islands began to dwindle. From thousands it has fallen to a few hundreds. Trees have grown up within the walls of abandoned convents. The church, however, is in perfect condition, and we found Father Ferrier ministering to the people of the Gambier Islands, where he had lived for forty-eight years. Another resident, an American figuring prominently in Eskridge's book, told us also native stories of "tupapaus" or ghosts, and of the mysterious black footprints which always predict calamity when they appear on the beach.

The summit of Mount Duff beckoned to me. As the side nearest the village was uncomfortably steep, I climbed by the gentler northern slope, through coarse grass at first, then shorter grass, ferns, and rocks higher up. From a shoulder near the top we saw a golden plover take wing with a shrill call, and here were dandelions in flower. Eight or ten tropic birds were flying about the peak, which rises some 1300 feet. Two of their nests we located, in crevices almost covered with ferns, each occupied by a single nestling, which protested with a long, trilling screech.

From this airy spot we could look down on the whole island and all its neighbors within the great reef. Off to the southeast we could just see Timoe, nearly thirty miles distant. The colors in the water were jewel-like. We knew how the Gambiers look to frigate birds—two were soaring in our vicinity—and I hated to go down into the heat of the shore.

Mangareva has a few white inhabitants who were born there. Clément Schmidt, who had charge of the dispensary, was the son of a Dane and a Chilean, and served in the army in France during the World War. Two of my evenings were spent developing photographs in the village jail, which had been vacant a long time. Its floor was littered with the skeleton of a goat that had wandered in to die. There had once been prisoners who had amused themselves drawing pictures with charcoal and signing their names on the white-washed walls. At Tondon's suggestion, I added my name to the roster, since I also had been a jail bird.

The old and the new

Modern Polynesia is full of strange contrasts: outrigger canoes and yachts with Diesel

motors, gold crowns on native teeth, sewing machines stitching Polynesian hats. As we threaded our way out between the treacherous corals, Monsieur Tondon was sending a radio message to the "Zaca," wishing us a friendly "bon voyage."

In four hours we were abreast of Timoe, an atoll two and a half miles long with palms and low trees. Here were boobies, frigate birds, red-tailed tropic birds, crested terns, noddies, and white terns, all of which should nest there. Landing through the heavy surf was hopeless. We could see the broken remains of the schooner "Pro Patria," wrecked while bringing Norman Hall back from Pitcairn Island.

It was now little more than a day's run to Pitcairn, two square miles of subtropical island supporting a community of world-wide fame. I expected it to be of far greater interest to Doctor Shapero than to me, for I knew its birds were few, and scarcely suspected the far deeper appeal of its human inhabitants.

The island was in sight on the evening of December 22. About twenty miles away the "Zaca's" motor was stopped, the helm lashed far over to starboard, and we drifted for the night. The electric light hanging in perfectly clear ocean water attracted some flying fish and a number of pelagic water striders (*Halobates*). These frail little skaters are sometimes seen a couple of hundred miles from land where no other insect dares venture.

Lonely Pitcairn

Pitcairn is often a dangerous anchorage. Yet we spent eight days there with good weather. We came in the southern summer, and the rains fall largely in winter. Two big whale-boats, each with fourteen oars, put off from Bounty Bay. Presently we had fifty-four men, one little girl, and a couple of boys crowding our decks. The total population is only slightly over two hundred. Conspicuous among them was Parkin Christian, Chief Magistrate for the year, a natural leader, with appropriate build and voice.

Each day except Saturday, their Sabbath, we went ashore in the islanders' boats, thirty-seven feet long, ideal craft for their cliff-girt home. The road from the boat sheds up to Adamstown was a steep two-hundred-foot

climb, this village being scattered over the sloping plateau above the cliffs along the north shore.

Higher up are wooded slopes and farms, the land rising to a rim about 900 feet above the sea near the south side, and to 1200 feet on the west. Norris Young volunteered to guide me, and over the whole island we tramped with Norris or his son Henry. We looked down the steep southern cliffs where Norris's brother-in-law had fallen while hunting goats, and where one of the first settlers met her death while gathering birds' eggs.

Only two land birds

At the time of our visit there were few sea birds nesting there. Common noddies and the smaller gray noddies do so, no doubt; and perhaps a few petrels. Red-tailed tropic birds were seen but they prefer uninhabited islands for nesting. Few boobies and frigate birds were seen at Pitcairn, and the sea bird breeding population has probably diminished greatly since it was settled.

The islanders told us that they had only two land birds, a "sparrow" and a "hawk." The sparrow proved to be a warbler, closely allied to that of Rimitara, very numerous everywhere in the trees, and exceedingly tame. Although it was breeding at the time, we never heard one of these Pitcairn warblers sing. Rather weak call notes were their only utterance. The so-called hawk was certainly the brown cuckoo from New Zealand that winters here. Of these Jaques saw just one, and I none, for it was the wrong season.

The woods on Pitcairn contain many of the usual Polynesian trees, one known as "miru" being so highly esteemed for its red-brown wood that the supply was running down. The tree called "tapau" was rather beechlike in general appearance. Another conspicuous tree (*Metrosideros*) varies somewhat from island to island, but had been seen in bushy form as far back as the Marquesas. The *Pandanus* forms open groves through which one may walk, and tree ferns (*Cyathea cumingii*) like those of Rapa are scattered through the higher wooded levels. There were at least two groups of very large banyan trees, with innumerable trunks and aerial roots. One introduced tree, the rose apple, was

rapidly spreading upward in the woods, crowding out the indigenous species. The cloth-tree (*Broussonettia*), the bark of which furnished the Polynesian tapa cloth, has almost disappeared. The fine coconut palms bear little or no fruit.

What with farming, goat-hunting, fishing, and the upkeep of their homes, the Pitcairn people find plenty to keep them busy. Produce and wood are trundled down to the village in rugged wheelbarrows. In their spare time the men carve canes and inlaid boxes from wood, which with baskets made by the women are sold on the steamers that stop well off the island on their way between New Zealand and Panama. Each evening after we returned safely to the "Zaca," the men in the boat would sing in chorus as they cast off to turn shoreward. A kindly religious spirit was very noticeable on Pitcairn.

Doctor Shapiro was the busiest of us all at this stopping-place, studying the islanders from every angle, making the very best of an opportunity he had sought for years, while Doctor Lyman, our surgeon, rendered them every possible service. On Christmas Day the annual elections were held, and two days before we left an outdoor afternoon dinner was given in our honor. The copious victuals included soups, fish, chicken, goat, white and sweet potatoes, salad, pumpkin pie, sliced pineapple, and lemonade or tea. Parkin Christian made a pleasant speech, to which Mr. Crocker replied most gracefully.

On the morning of New Year's Day a large share of the populace came out to bid us goodbye. A race was rowed between two of their large boats, and then toward noon came the last farewell, with the singing of "God be with you." These fine people had won our deepest respect and sympathy. A little before sunset Pitcairn was so low on the horizon that it seemed split in two. One half began bobbing up and down behind the swells, then the other appeared to divide in three, and as darkness fell just one small bit remained in view.

Another day of smooth sea followed, and on the morning of the third day Ducie Island appeared, a low atoll with two main sections bearing many low trees and bushes. We speculated as to the possible kinds of trees and other plants we should find. But as soon as we

had waded ashore, it became evident that every tree and bush belonged to a single species, *Tournefortia argentea*, of the heliotrope family. Neither could we discover any other flowering plant or even a fern. Some of the *tournefortias* rose like trees, others branched from the ground up into large dome-shaped shrubs.

Along the beach like a straggling committee of welcome sat white boobies (*Sula dactylatra*) with their young. Red-footed bobbies (*Sula piscator*) and frigate birds (*Frigata minor*) nested in low trees. Noddies and white terns were there, too. Hearing strange noises under the shrubbery, we crawled in and found a small blackish shearwater (*Puffinus nativitatis*) and the slightly larger Kermadec petrel (*Pterodroma neglecta*) nesting there. A few of their eggs were seen and four or five of their fuzzy gray young, like powder-puffs with eyes and a beak projecting from one end.

Equally delighted we were to find red-tailed tropic birds, each with a nestling or a single egg in a shady hollow amid coral fragments. The strawlike middle tail feathers, coveted by natives, can be plucked from the sitting bird.

On the beach of this remote island lay many pieces of timber. Some were old ribs of a ship, with large copper bolts. What a place to be wrecked! A year might easily pass before any ship would come near Ducie.

Heavy weather

Our friends on Pitcairn had prayed for fair weather during our long voyage to Easter Island. For two days beyond Ducie their hopes were fulfilled. Then an easterly wind began to kick up a sea. The spell of bad weather and head winds that ensued lasted a full week. Day after day we tackled, usually with one motor running. Seasoned though we were, we found our sea legs none too steady. A day's run scarcely averaged eighty-five miles and one was only thirty-six.

About midway between Ducie and Easter, late one afternoon, came the cry "Ship ahoy." She was the steamer "Mahana," bound from Wellington for Panama—the first ship we had seen when out of sight of land, after cruising some 6500 miles.

Near noon on January 13 we sighted the northern corner of Easter Island, 1969 feet high without any protruding peak. A couple of hours later the southeast corner, occupied by the great crater of Rano Kao, rose from the sea. Next followed some intervening cones, like little islets between the big ones, and finally the whole mass fused together.

Doctor Shapiro has already described this unparalleled island in *NATURAL HISTORY* for May, 1935, with special attention to its people and their history. I shall deal mainly with its birds. The man who insisted on serving me as guide was Moises Tuki, a step-nephew, as one might put it, of Clément Schmidt of Mangaeva, but with considerable native blood. The elder Schmidt left offspring on both islands.

On foot and on horseback we covered much of the western part of the island, which is roughly triangular, about thirteen miles across. Easter Island was reputed to have two species of land birds, both introduced from South America. One was *Pezites militaris*, a red-breasted troupial, which Moises assured me had become extinct. The other, a tinamou (*Nothoprocta perdicaria*) is now abundant in the open grasslands that cover nearly the whole island. It rises like a partridge on whirling wings, with a reiterated whistling note, but is not easy to put up a second time.

Other birds, however, have been introduced more recently. House sparrows from Europe, probably by way of Chile, are common about the village. Near the groves of trees planted in the vicinity lives a gray Chilean finch, *Diuca diuca*. One of the common birds of prey in Chile, *Milvago chimango*, has likewise been liberated, and a few pairs now frequent the crater rims of Rano Kao and Rano Raraku.

Egging competition

In olden times the people here developed a strange interest in bird study. A yearly competition arose to secure the first egg laid by a sacred bird which returned annually in September to breed on the islets off the southwestern corner of Easter Island. To me these rocks were of great interest as the principal home of the sea birds living about the island. Kao-Kao, nearest to shore, is a single rock, towering up over two hundred feet. Motu Iti (little island) and Motu Nui (big island)

lie farther out, close together. They are lower and broader, and on them live by far the greater number of birds.

There nest the sooty terns (*Sterna fuscata*) still known as "manu tara" or sacred bird because theirs was the coveted egg. Their numbers were hard to estimate. Flocks of considerable size were always going out to fish, and I have counted two hundred flying off at our approach, the air filled with their excited, ringing calls.

There may well have been five times that number breeding on the two islets. Common noddies must be about equally abundant, and the smaller gray noddies were seen in lesser numbers. A few white terns live there, though there are no trees. Over the waters near by there were usually some gadfly petrels (*Pterodroma heraldica*), and sometimes a dozen flew back and forth over the top of the islets. One day six frigate birds took wing from Motu Nui. About the steep sides of Kao-Kao noddies hovered and cawed, while a half dozen white boobies sat placidly near its summit. Red-tailed tropic birds seemed to prefer the high cliffs of the main island.

The natives, I found, are still interested in the birds of the islets, though the social significance of their egg hunt vanished nearly seventy years ago. One morning I stood looking out from Orongo, the group of stone huts on the mountain where notables used to gather during the "egg race." Down off Motu Iti a rowboat was tied, and some men on the rocks were collecting eggs. A second boat was passing Kao-Kao rock, and landed at Motu Nui. The egging party soon assembled on Motu Iti about a fire, and we saw them return to the village that evening.

It was a real privilege on my last day to visit Rano Raraku, where all the huge images were carved, and where many are still standing. Before these grim relics of a past without history, ornithology was forgotten for a time, until a pair of hawks with a nest in the neighboring cliff came swooping down at us in noisy protest.

Six days on Easter were an experience to be cherished. The next land on which we would set foot, the outer island of the Juan Fernandez group, was 1545 miles away. There lives a large humming bird, proclaiming the land as American.

Through Southern Polynesia

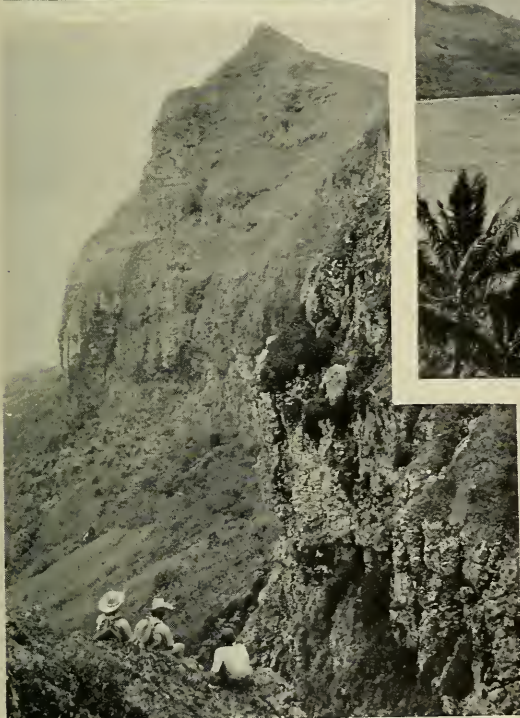


Photographs by Toshio Asaeda

(Top) Coming ashore on Rimitara, Doctor Lyman walks gingerly over the weed-grown reef and around the clear tide pools

(Center) Avera Bay at Rurutu is almost filled by a broad reef, built perhaps in larger measure by algæ than by true corals

(Left) On the way to Mt. Hiro on Rai-vatae, the party rests and looks ahead from a notch in the ridge





Women of Rapa making "poi" of taro root. The sticky cold pudding is then wrapped in green leaves

Papeete is strangely flyless, but Rapa has plenty. Every return to the yacht adds its unwelcome quota

Ahurei village on Rapa, marked by its large white church, has a background of old volcanic pinnacles



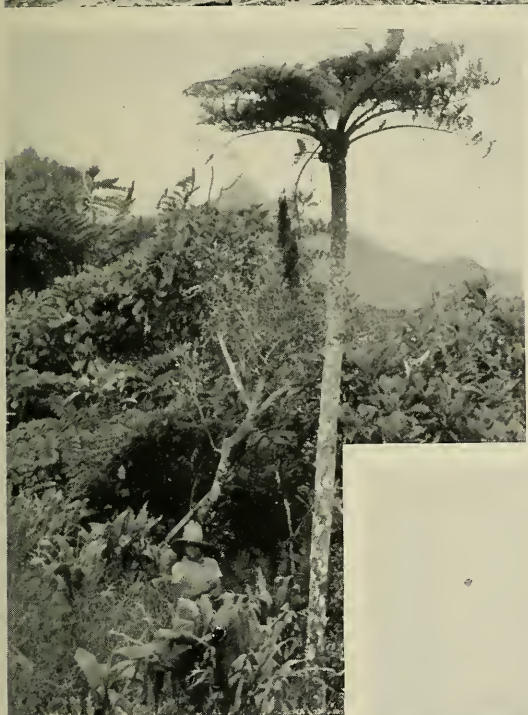
Photographs by Toshio Asaeda





Toshio Asaeda

(Above) The kitchen in Rapa has no roof, and its primitive utensils serve side by side with old iron oil-barrels



(Left) Tree ferns adorn the thickly wooded hillsides on Rapa, where the luxuriant vegetation is a pleasant surprise

(Below) An old fort on a hilltop. Would that ghosts might arise to tell of their battles long ago





Toshio Asaeda

(Above) The mausoleum of King Maputeoa, stands below the cliffs of Mt. Duff



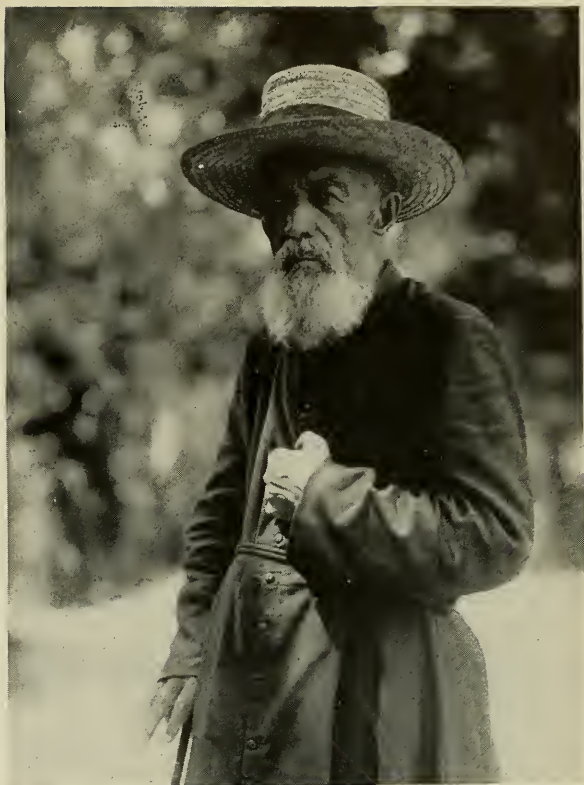
(Left) The sweet-scented Tahitian gardenias are favorites for garlands

(Below) Rikitea harbor, a delight for the colors of its water, and the town hidden in palms



Toshio Asaeda

Father Ferrier, the elderly French missionary to the Gambier Islands, has walked the shady streets of Rikitea for nearly half a century. Many a change has he seen in the life of his once-savage flock



The majestic church of Rikitea fronts on the end of a main avenue traversing the town. It symbolizes the victory of the Christian world over the cannibal customs of ancient Polynesia



Toshio Asaeda



Toshio Asaeda

Pitcairn Island from the northwest, still much the same, from a distance, as it must have looked to Fletcher Christian

Its woods suggest a fertile soil with sufficient rainfall, two of the prime necessities for the mutineers' colony

Parkin Christian, a "first citizen" of Pitcairn, Chief Magistrate in 1934, standing at the prow of his boat

The residence of Edgar Christian, who was elected Chief Magistrate for 1935, with Goat House hill in the background



A Pitcairn warbler at its nest in the crown of a "ti" plant, unafraid of the photographer a few paces away



Under the banyans of Pitcairn. Banyan trees are wild fig trees, introduced by man, and their small fruits are eaten avidly by pigeons on other islands



This warbler sat patiently on its nest all the while the author climbed the spiky Pandanus tree with a heavy camera





Toshio Asaeda

Cultivated fields on the eastern end of Pitcairn where most of the crops of the islanders are grown



Looking down on Adamstown from Goat House hill, about a thousand feet high, to the westward

The central slopes of Pitcairn are only partly farmed, much of the woodland being wisely conserved





Toshio Asaeda

After every landing at Bounty Bay the heavy boats are dragged up conscientiously under their sheds. A rack of heavy poles protects their keels. The risk of leaving them in the water is suggested by the white surf rushing in amid the great rocks

The visitors from the "Zaca" being dined at Adamstown. Parkin Christian sits at the right of Mr. Crocker, while the hosts of both sexes busy themselves serving the meal. Steamship caps are the most fashionable headwear for young Pitcairners



Toshio Asaeda



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Immature masked booby on the beach at Ducie, unafraid of human beings. Birds of this species sometimes dove at

the fish-line trailing from the "Zaca's" stern, mistaking the hook and rag for a fish

Old masked booby sheltering its chick from the summer sun beating with special fury on a white coral strand

A pair of Kermadec petrels under the bushes on Ducie, wanderers of the sea come home to nest





Red-tailed tropic bird incubating its egg in a shady hollow on Ducie. About ten large feather-flies are resting in the

plumage of its neck, without apparent inconvenience to the bird that nourishes them

Downy chick of the Kermadec petrel, well fed with predigested squid, and as fluffy as a bird can be



Male frigate bird on Ducie Island, perched in a brittle Tournefortia tree. A robber baron among birds of the sea





Toshio Asaeda

Downy young of the masked booby, now able to stand up by itself on a rock, with strong wing and tail quills growing rapidly



Toshio Asaeda

Young frigate bird on its nest of sticks in a bush, where it is fed with fish stolen from boobies and terns by its tyrannical parents



(Top) Three bird islets off Easter Island, seen from Orongo on the rim of Rano Kao crater

(Center) Image of a "tangata manu" (bird-man). Its head is very suggestive of a frigate bird, perhaps in reference to the predatory nature of that bird

(Right) An Easter Islander who came aboard wearing about his head a woven band decorated with the white breast-feathers of the once sacred sooty tern





Front of one of the gloomy stone huts at Orongo, where the Easter Islanders used to watch the sooty terns. No wood entered into their construction, and the roof of flat stone slabs was covered with earth

The crater of Rano Raraku, where the celebrated statues were all quarried, holds a fair-sized reedy pond. These well preserved craters furnish the best proof that Easter Island is geologically very young



Toshio Asaeda

Native American Food

What the Indians gave us to eat and how their discoveries influenced the dietary habits of the world

By GREGORY MASON

IN all the story of primitive man, one of his most far-reaching achievements is the invention of agriculture. When man developed the cultivation of crops and thus freed himself from the dangerous and harried existence of a hunter, he spanned one of the broadest gulfs separating savagery from civilization.

It is not surprising, therefore, that the archaeologist, in piecing together the picture of human progress, brings into consultation his confrère the botanist. And in no field of archæology is this collaboration more important than in pre-Columbian America.

The forgotten red man

It was not until nearly four hundred years had passed after Columbus saw that fateful light in the Bahamas on the murky morning of October 12, 1492, that the American Indian was given anything like his due as an originator of crops. Most American plants were misnamed and falsely attributed to Old World origins (as many other American institutions still are), until in 1884 Alphonse de Candolle in his "Origin of Cultivated Plants" gave them something like their rightful place. The United States Department of Agriculture then pressed forward investigations which conceded more and more credit to the pre-Columbian red man and his wooden, stone, or clamshell hoes, until Lyman Carrier, a co-worker in the Department, with such well known men as O. F. Cook and W. E. Safford, published his *Beginnings of American Agriculture* in 1923.

The argument is about over. The red-skinned farmer is belatedly but dramatically vindicated with the reminder prominently displayed in the Southwest Museum, of Los Angeles, that we owe *five sevenths of the world's agricultural wealth* to the American Indian.

A neglected page of history

A historical romance could be written about how we modern Americans and Europeans have come into possession of many food products now in daily use which were bequeathed to us by the so-called "barbarians" who enjoyed the Americas alone before the white men intruded.

Some of the best gifts of the New World, of course, were wild: pineapples and strawberries, many other kinds of berries, plums and persimmons. Edward Winslow wrote to England from Cape Cod in 1621:

Here are grapes, white and red, and very sweet and strong also strawberries, gooseberries, raspas, etc.; plums of three sorts, white, black and red, being almost as good as damson.

Similarly, the Indians ate many nuts which they did not take the trouble to cultivate. Walnuts, pecans, chestnuts, chinkapins, hazelnuts, acorns—these were gathered wild by the aborigines. Probably the whites were the first to plant nut trees and tend them, although this interesting point is somewhat shrouded in mystery. Sunflower seeds gave the aborigines an oil they used as a dressing, as well as a flour which they used for bread.

Some of the nuts just mentioned gave them flour, especially the acorn, and so even did the

common wild cane of the Mississippi Valley. Wild rice was not only popular because it lured the ducks to Indian snares and arrows but because it was itself an excellent food for man. Here we have followed the Indian in both respects. Our hunters plant wild rice to attract ducks to their preserves, and our gourmets consider the grain itself a delicacy.

Few domestic animals

Historians and anthropologists are fond of making much of the fact that the early Americans were very poor in domesticated animals. It seems likely that they had none of importance except the llama, the turkey, and the dog, and of these only the dog was eaten, the llama being valued for his wool and the turkey prized for his feathers. The muscovy duck and the guinea pig were domesticated, but they played no significant part in the economy of the Indians. The curassow and alpaca also might be mentioned, but they are close to the turkey and llama, respectively.

But as Dr. O. F. Cook has pointed out:

The comparative deficiency of the Western Continents in fruit and animals suitable for food is compensated by numerous starchy root crops. Throughout the tropics of America, the Indians, like the Chinese, preferred everything cooked. This habit must have been adopted very far back to have made possible the obviously ancient domestication of Manioc (cassava), Colocasia (taro) and Xanthosoma (yautia) since the fleshy underground parts of these plants contain substances distinctly deleterious until disintegrated and rendered harmless by heat.

It is from about here that Doctor Cook goes on to his surprising contention that since America had six of the seven chief food plants of the Polynesians, and all the root crops which attained any wide distribution in Asia and Africa, "we are not without numerous indications that agriculture proper, together with the agricultural organization of human society which lay behind modern civilization, originated in America and has now completed the circuit of the globe." This conclusion is not subscribed to by the majority of botanists, but it had the great merit, like the work of De Candolle and Safford and Carrier, of giving some justice where justice had long been withheld. American anthropologists, overawed by the fact that the New World has produced no

traces of anthropoid apes, seem to have allowed other aspects of their science to suffer through a sort of hemispheric inferiority complex. Today most botanists admit that irrespective of the difficult matter of estimating comparative age American agriculture was more intensively developed from the wild plant prototypes than that of any other people at the time Columbus set out on his foolhardy voyage.

But there are still some points to be settled. Four important plants, sugar cane, fig, coconut, and banana, are still doubtfully attributed to America by some experts. The last two are perhaps especially important in any attempt to work out the history of migrations and the contacts of ancient peoples. Mr. W. J. Perry and others believe that the Peruvians had two cultivated varieties of the banana, but most experts think that the banana had an Asiatic origin. Moreover, off the West Coast of South America grew a single wild species of coconut unknown in the West Indies when the white man came, and Perry thinks that the coconut originated in America. De Candolle, however, attributes it to the East Indian Archipelago.

In all the discussions of the origin or origins of the peoples of the "South Sea Islands," Polynesians and Melanesians, and of their relations to America—if any—the coconut plays an important part. If proof is forthcoming that America did not get the coconut from Oceania or Asia or Africa and did not get the banana from outside either—as Doctor Cook believes—anthropological argument would develop fresh intensity and a new slant. The weight of opinion, however, attributes both these food plants to non-American origins.

Poisonous plant made edible

If you were brought up in New England, you may, like the present writer, have had an early acquaintance with desserts called tapioca pudding and tapioca custard. The story of this thing we call tapioca is one of the most interesting romances in botanical history. The particular interest, both anthropological and human, surrounding tapioca, or manioc, as a primitive food lies in the fact that the plant is poisonous until it has been treated by a complicated process. Indeed, one can hardly call "primitive" the pre-Columbian American Indians who devised and used this process for

uncounted centuries before the "Santa Maria" broke up on a shoal off Santo Domingo.

Manioc is a root, and the poison it contains is prussic acid. The Indians of the past, and the Indians of today, grate the root and then squeeze it in a basketry press, called a "snake" because of its shape, to remove the juice. The pulp is then formed into cakes and heated until the residue of volatile poison is driven out. What is left is cassava bread, a staple food of many American Indian tribes, especially in South America. The thing the first Europeans to visit Virginia called cassava was really wampee, but like cassava it had to be carefully treated before it was safe to eat.

How many millenniums had human culture developed before man had the ingenuity to get rid of the poison in manioc root? It is questions like these which fascinate botanists and anthropologists, and increase their admiration for primitive man. So, the next time you eat tapioca, pause a second before you put the first spoonful into your mouth and thank some Indian shaman of long ago. Or perhaps you will curse him.

The once "deadly" tomato

One of the greatest gifts of the Indian to the world is the "Irish potato," which is neither Irish nor a potato. *Solanum tuberosum* is really a member of the nightshade family, and hence related to the tomato. Incidentally, the fact that many members of this family are poisonous (for example, the famous "deadly nightshade") is one reason why the tomato was widely shunned except in South America, its home. White people refused it as a "poison apple" right up to the days of our grandmothers.

The true potato is the sweet potato, a member of the convolvulus or morning-glory family, and was probably first encountered by Europeans in the West Indies—when the natives gave men of the first Columbus expedition "some boiled roots to eat not unlike chestnuts in taste. . . . There was a great deal of tilled land, some sowed with these roots." The sweet potato became very popular among the whites and was soon transported to Europe, where it did well in Spain, Portugal, and parts of Africa. A South American origin is attributed to the sweet potato by the United States Department of Agriculture. Research is now

being carried on by the Bishop Museum which may produce valuable evidence for or against this belief. This research is directed toward a determination of the relationship between the American variety and the Polynesian variety of sweet potato, by a study of the chromosomes.

The travels of the potato

The white potato never grew in America north of Colombia until Irishmen brought it to Londonderry, New Hampshire, in 1719, after one of the most remarkable and ironical voyages any vegetable ever accomplished. The first white man to see it was Pedro de Cieza de Leon who, in 1538, in the Cauca Valley of Colombia found the natives living well on quinoa—a cereal much like hominy—and this "kind of ground nut, which when boiled becomes as soft as a cooked chestnut, but which has no thicker skin than a truffle."

About 1580 Spanish ships took this "truffle" to Europe; where via Vienna, with the careful nursing of Charles L'Ecluse, it reached Germany. There it is still known under the misnomer of truffle (*kartoffel*). It made no great stir in Ireland until 1663, but once in the Emerald Isle it was taken up with great enthusiasm, for not only was it recognized as a good substitute for the staple oatmeal (potatoes dipped in salted milk became the daily diet of the Irish peasantry), but the sons of Erin found that it made a good whiskey.

A few years after the Irish sent the white potato to New England they sent it to the West Indies—only a few hundred miles north of its origin. Thus, thanks to white adventurers, in two hundred years this prosaic looking tuber had circled the civilized globe. And wherever it has since gone it has held its own, really, in many respects, the most remarkable plant man has domesticated.

As the Irishman learned to use the Indian's white potato both for food and drink, the red man himself was well aware that another crop could provide drink as well as sustenance. The reference is, of course, to "Indian corn," or maize, the most important gift of the red man to world agriculture, and possibly the oldest cereal in the world. Just how long it took the Indian to develop corn from the wild Mexican grass called *teocintli* it is impossible to estimate; but that *teocintli* was the wild prototype

is practically certain. Tizin, or maize beer, was a favorite drink of the Aztecs of Mexico, who inherited it perhaps from a much earlier people. Today in Central America the degenerate modern Mayas still hold "maize masses" at planting time—ceremonies religious and bibulous, not entirely unlike corn-husking ceremonies in Nebraska.

Usually, when primitive man travels, he carries some food plants with him. But if man first came to America from Asia, as is the orthodox belief, he came at such an early stage of his development that he brought no Old World cereals with him. So he developed his own cereals, quinoa, maize. Perhaps he used root flour before grain flour. Well, he had all the root crops which attained any wide distribution in Asia and Africa and many others besides. His languages, like his agriculture, show no indication that they were brought to America from Asia, Africa, or Europe.

Varieties of maize

The Indians had more varieties of maize than we have today. In Canada they had one which ripened in three months, while the subspecies they used in Texas took five months. Such freak varieties as the flint maize of New England and the dent maize of our Middle West we owe to these Indians, as well as that delight of our children, popcorn.

We owe to the Indian not only our varieties of corn but our methods of planting and tending it. And we borrow the habit from the Indian of planting other American vegetables with corn, such as squashes, pumpkins, and varieties of beans. Listen to this tribute to Indian husbandry from an Englishman named Wood writing in his *New England Prospect* in 1629:

They excede our English husbandmen, keeping it so cleare with their Clamme shell-hooes as if it were a garden rather than a corne-field, not suffering a choaking weede to advance his audacious head above their infant corne, or an undermining worme to spoile his spurnes.

Not even a cursory account of American Agriculture like this could omit the subject of rubber. Few of us modern Americans realize that rubber is just one more thing in our everyday life that we owe to the Indian. Like another Indian product, quinine, to be sure, rubber

has been transplanted and is today produced most successfully in Asia. But the material we use in our automobile tires is the same that the Indians used in making a ball for a game which they played resembling basketball. The Aztecs played this game, Tlachtli; and the Mayas or Toltecs before them may have invented it.

Cotton, however, is one of those plants which both the Old World and the New World had before they met. The Mayas and Mexicans had cotton so fine that the Spaniards took it for silk, and cotton so strong that it was used as armor against wooden swords armed with the sharp volcanic glass (obsidian). The best modern commercial varieties of cotton are the so-called Sea Island and the misnamed Egyptian varieties. Both of them were developed by the American Indian.

Drinks and drugs

So was cocoa, ipecac, cascara, balsam Peru, and other drinks and drugs which we take for granted. The pulque of the modern Mexicans is a descendant of the *octli* of the Aztecs. The Caribs, that great South American people, did their fighting on beer made of the cassava already mentioned. The peculiar institution we modern Americans have attempted to establish, known as Prohibition, had no appeal to any ancient Americans except the Aztecs, who imposed this and other austerities upon themselves such as might appear to be related to what we today call "Puritanism."

The list of drugs we owe to the Indians would not be complete without mentioning cocaine, which is derived from coca—a plant indigenous to South America. There is quite a little evidence to indicate that the first use of local anæsthetics was made in South America, probably in the pre-Inca region, and that the drug used was coca.

The leaf of this plant is still chewed by South American Indians who find that, particularly when mixed with lime, it gives them a great renewal of energy for mountain trails. United States doctors recently made the same discovery about the relationship between coca and lime, and were much surprised when informed that bush red men in South America already knew all about it.

Another product for which the world owes thanks to the American Indian is tobacco. The

weed was originally tropical, and the art of using it spread from tropical America until its culture was more widespread than maize. Tobacco was smoked, eaten, and drunk. Today semi-liquid tobacco is still eaten or drunk by the Kagaba-Arhuaco Indians of northern Colombia, being carried by the men in a viscous state inside a small gourd.

In aboriginal America the use of tobacco was not confined to men, however. Inasmuch as the "noble weed" was considered good for the health it was used by both sexes and at almost all ages.

The first European to see it was Columbus, who found the natives of the West Indies very fond of cigars. In Middle America a leaf was often rolled into a rude cigar and then pushed into a hollow holder of wild cane. Similarly in the region which is now the Southwest of our country the hollow reed method was employed. To the East and West of this region the white explorers found that this reed had developed into a tubular pipe of pottery, stone, or wood, which had to be smoked almost vertically. A way around this inconvenient posture was found by Indians in the Central and Eastern part of what is now the United States when they put a bowl on the pipe.

The chewing of tobacco was popular in the Andean region of South America, although in many parts of this area the custom of chewing coca (from which we get cocaine) drove it out. However, this writer found that the Kagaba tribe of Colombia, above mentioned, still absorbs both coca and tobacco through the mouth. In much the way these Indians eat coca with lime, red men on the Pacific Coast of North America swallowed lime with tobacco. The lime increases the effect on the human system of both drugs.

Tobacco as money

The white colonists took up the tobacco habit with such avidity that in Virginia the weed once passed as currency, and some of the Elders were worried lest so much land be given to tobacco that the food crops would prove insufficient.

Before this the Spaniards had carried tobacco to Europe. (Sir Walter Raleigh was not the first person to do this, as some of us were taught in childhood. The first Englishman to get the weed obtained it from sailors of John

Hawkins). From Spain it went to Portugal. In 1560 Nicot, French Ambassador to Portugal, carried the fragrant herb to France and modestly gave it the botanical name of *Nicotiana*—whence comes our word *nicotine*.

Spanish, Portuguese, and Arab traders, sailors, and adventurers introduced the smoking habit into ports of Asia, Africa, and the East Indies. From there it went inland, so that years later explorers found natives of Africa and New Guinea growing and smoking tobacco although they had never seen white men. They told the white discoverers that their ancestors had had the weed time out of mind. Thus there came out reports denying the sole American origin of tobacco. But we know now that the first tobacco was American, and Dr. A. L. Kroeber has pointed out that the foregoing facts indicate how short-lived is group memory and how unreliable is oral tradition.

It is interesting to note that smoking reached the American Eskimo only after making a circuit of the globe—the pipe with peculiar flaring bowl used by the Eskimo having reached them from the Siberian Chukchi who were taught to smoke by Russians. Another curious item is that stone pipes in the form of tomahawks used by the Sioux and Blackfeet actually were imitations of metal hatchets in the form of pipes introduced on the Atlantic Coast by early English traders. The indigenous pipe of the Sioux and Blackfeet was an outgrowth of the tubular pipe—with bowl set well back from the end of the stem.

Fortunately at long last we modern Americans are beginning to recognize the splendid, independent accomplishments of aboriginal American agriculturists. At least five sevenths of the products we consume at any big dinner in the United States today are made up of things we owe to the American Indian, from the pre-prandial tomato juice to the post-prandial cigars.

Tastes and fads may change, but the basic products upon which our nourishment depends are the same that primitive man so laboriously won from the wilderness. Civilization allows us to enjoy culinary arts that are far more complex than theirs were, but let us not forget the first farmers of the Western Hemisphere, who all unknowingly did so much toward prescribing our diet.

NATIVE AMERICAN

Not until nearly four hundred years after Columbus discovered America was the Indian given anything like his due as an originator of crops. It has been estimated that we owe five sevenths of the world's agricultural wealth to the red man

(Left) Maize, or corn, was probably the most important gift of the Indian to world agriculture. The Indians cultivated more varieties of this cereal than we do today, and even provided that delight of our children, popcorn



The Irish potato is not Irish but Indian. White man did not know of it until 1538, when it was "discovered" as a staple of the Indians of Colombia. About 1580 Spanish ships took the potato to Europe, but it was not until almost a century later that it began

to make a name for itself in Ireland. Potatoes dipped in salted milk became the daily diet of the Irish peasantry; and the sons of Erin also found that the potato made good whiskey. In many respects the white potato is the most remarkable plant man has domesticated

One of the most astonishing food discoveries man ever made was that the poisonous tapioca plant could be rendered edible by a complicated process. The persons in the photograph at the right are scraping and grating the manioc root, as it is called, prior to subjecting it to the process which the primitive Indians almost miraculously hit upon. The grated root is squeezed in a basketry press to remove the juice and then heated until the last of the prussic acid is driven out



Ewing Galloway Photograph

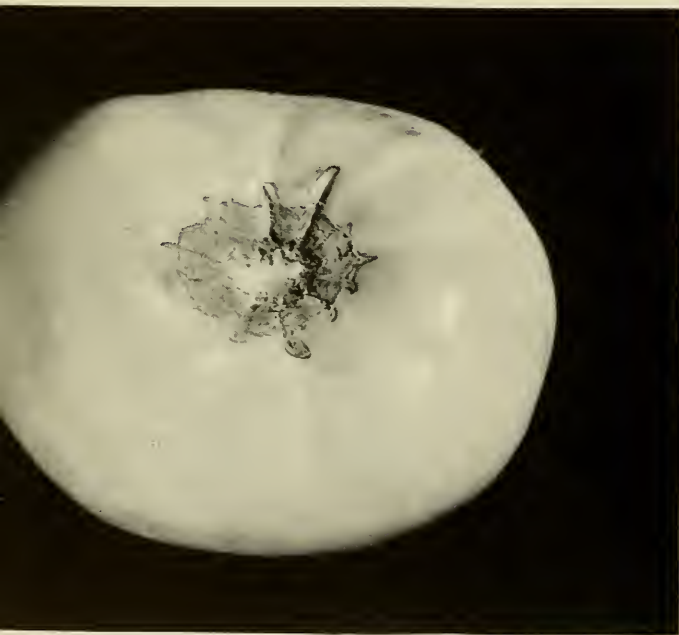
(Above) The lima bean, like several other varieties of beans, is native to America

(Right) The sweet potato was probably first encountered by Europeans when natives offered it to men of the first Columbus expedition





The turkey was domesticated by the Indians, not as food but for its feathers



ing Galloway Photographs

The tomato, a native of South America, was shunned elsewhere by white people as a "poison apple" right up to the days of our grandmothers





Living Galloway Photographs

(Right) A choice native American food which grew wild—the pineapple



Globe Photograph

Squashes (left) and pumpkins (above) are among the many other products that the first American farmers gave to civilization



Before the discovery of America only the Indians used tobacco. Englishmen first got the weed from sailors of John Hawkins (not from Sir Walter Raleigh). The use of it has spread to every land on the globe



Ewing Galloway Photogr

A native of the upper Amazon tapping a rubber tree. Rubber is another product that the Indians were the first to use. The Aztecs played a game like basketball with a rubber ball

Wings Over Waves

A review of a monumental work, "Oceanic Birds of South America," by Robert Cushman Murphy

By WILLIAM VOGT
Editor of "Bird-Lore"

EARLY in the summer of 1912 the New Bedford whaling brig "Daisy," setting out on a cruise to the South Atlantic Ocean to secure sperm whale and sea-elephant oil, carried with it a young ornithologist, Robert Cushman Murphy, who represented the American Museum of Natural History and the Brooklyn Museum. By agreement with the owners of the brig he was to collect birds at sea whenever an opportunity offered, and to have three or four months during which he might study and collect birds on South Georgia, an antarctic island.

Some six months later Mr. and Mrs. Rollo H. Beck departed from the United States, to which they did not return until September, 1917, on the Brewster-Sanford Expedition. During these four-and-three-quarter years the Becks virtually circumnavigated South America—collecting as they went—and made many tangential journeys to island bird communities, as well as into the interior. Their scientific spoils included nearly 8000 specimens of birds.

Absorbing and exciting

In the making of this book, these were the most important field investigations. There were others, that contributed greatly, but the South Georgia expedition gave Doctor Murphy his fundamental field experience with insular and sea birds; and the Becks provided an enormous amount of study material, systematically accumulated over a wide area.

For nearly twenty-four years the studies have germinated. The author has, meanwhile, attained international eminence as an ornithologist and geographer; he has followed the

deepening trail of his own investigations through publications from both hemispheres; and, perhaps most important of all, he has had sufficient time to submit his wide-ranging speculations and enthusiasm to the test of his own maturing critical faculties. The result is not only an ornithological work of the first magnitude, but one of the most absorbing and exciting publications in the field of natural history.

A new world revealed

If the word "exciting" seems too undignified for such an important contribution, it is the fault of the English language. A volume that stirs the imagination, quickens one's pulse, makes one long for horizons wider even than the geographer's, and permits one to look forward and backward along the corridors of time, is exciting whether the word sounds dignified or not!

The destiny that shapes our ends, is, in the long view, not very different from that controlling the shearwater passing Jones Beach on its way toward Tristan da Cunha. The bird's vicissitudes are, to a large degree, ours. We are compounded of the same elements and derive our existence, by not so different a route, from the same sunlight, air, and chlorophyll. If we so far lose sight of essentials that, to use a timely example, a strike of "service" employees—forcing us to climb an unwonted eighty-five feet—seems of more serious import than the "Niño" on the coast of Peru, we have become myopic indeed, and need such a book as this. Whether we need it or not, through its pages we may roam distant seas and enter the same social set as an emperor penguin or a sheathbill!

A reader need not be an ornithologist to lose himself in this work. Indeed, the author says, at the outset:

Let us preface and mingle our account of the bird life with notes upon the structure of the South American coast, and also upon drainage, meteorology, ocean currents and other phenomena that help to make the littoral and pelagic environments what they are. Let us include, furthermore, a running description of the salient coastal features, seeking the impressions that circumnavigators of the continent would gain if their craft might hug the bends of the highly varying shore throughout the whole voyage of some 27,000 kilometers. Only by such attempts to correlate life and its physical background can we hope to comprehend the place of the native sea birds in the scheme of nature.

We shall draw our information from any available source—manuscript notebook, periodical, work of travel, geographic text, mariners' pilot book, or even fiction if the descriptions seem warranted.

After a brief introduction to the South American continent, the author discusses in lucid detail its general meteorology, an especially important factor on this area of starkly delimited aridity and rainfall. The effects of hurricanes upon birds are considered in a fashion that will be especially interesting to New Yorkers, in whose region many storm-borne waifs are prone to appear.

Life zones

Under "The Hydrology in Relation to Oceanic Birds," Doctor Murphy considers such factors as the following:

Life zones governing the distribution of birds at sea are ultimately determined by physical properties of the surface waters. The well-nigh inexorable control of certain special types of oceanic environments upon birds has not yet been generally realized by either zoologists or oceanographers. The distributional boundaries and barriers of animals inhabiting land areas, such as mountain walls, deserts, broad rivers, lines of abrupt change in temperature or rainfall, etc., are accepted as a commonplace. . . . But oceanic birds seem, in the main, to have been regarded somewhat naïvely as aerial rather than aquatic animals, notwithstanding that their relationships to sea and land, as concerned with feeding and breeding, respectively, are precisely the same as those of the seals among mammals or the sea turtles among reptiles. . . .

In this book we shall have abundant opportunity to note how the majority of oceanic birds are bound as peons to their own specific types of surface water. . . .

In support of his contention he describes the various zones of surface water about South

America, ranging from the Antarctic to the Tropical, and with well chosen, often vivid phrases, summarizes the life conditions that obtain in each zone. (In none of the book, it should be well noted, is man forgotten; man's existence is often interwoven with that of the birds and, in any case, the human element furnishes a vivid key to understanding that is repeatedly and skillfully used.) Ocean currents, often modifying surface water zones and dominating them, are next considered in relation to the birds. Admirable diagrams and charts make understanding easy, and here, once more, facts emerge that make the earth a more interesting habitation. For example:

Cephalopods, of all oceanic invertebrates, make up the greatest single food resource common to widely varying zones. In cold waters the chief combination of importance to birds is probably cephalopods, crustaceans, and small schooling fishes; in warm water cephalopods and flying fish take high rank. But cephalopods and fish are at least ten times as abundant in the surface waters beyond 40°S., and in coastal currents, as they are within what we may call collectively the Sargasso regions; and the corresponding ratios with reference to crustaceans are nearer ten thousand to one.

The Humboldt Current, that great cold oceanic river that flows up the western coast of South America, is treated in detail, as it deserves. One of the most interesting of terrestrial phenomena, it thrusts typically cold-water animals and plants northward until penguins are found breeding almost on the equator. "El Niño," the equatorial counter-current, provides Doctor Murphy with the opportunity for some of the most dramatic writing in the work. At long periods, this current that flows southward from the tropics gathers impetus and impinges on the broad safety-belt of the Humboldt Current—

Catastrophe to sea life

The immediate result of an advance of El Niño is to raise the temperature of the littoral ocean water by five or more degrees Centigrade. The normal plankton of the cool Humboldt Current waters next succumbs, perhaps because of the increased temperature, perhaps in part because of a different composition of salts in the water. The common schooling fish leave the region or die, and less familiar species such as flying fish, dolphins, and other tropical types, invade the shore waters and even enter harbors. Later, if the incursion of tropical waters is marked and widespread, disease attacks the population of cormorants, boobies, pelicans, and other guano birds belonging to the nor-

mal Humboldt Current fauna. Carcasses drift ashore in vast numbers, and the survivors of such species are driven southward.

On the occasion of the last cataclysm of this nature, Doctor Murphy had the grim good luck to be in Peru. It is thought to have been the most far-reaching shift of "El Niño" within historic times and this author's descriptions of the *bouleversement* of the vital equilibrium of the region read like something out of Jonathan Swift. It is unfortunate that the account is too long for quotation here.

This is as appropriate a place as any to comment on the writing of the book. There is a tradition among many scientists that if they have something to say, the manner of saying it is quite unimportant. As a result, some scientific journals read, at times, as though their contributors had not passed beyond grammar school; indeed, so badly have some recent ornithological papers been written that certain sentences were literally meaningless.

High literary merit

In the matter of presentation of material, *Oceanic Birds of South America* is a model. It often concerns itself with difficult, involved problems that will be new to many non-professional readers. So logically is the story given, however, and in such felicitous language, that the mind absorbs this "intellectual pemmican" as easily as the eye runs over the words. The text is refreshingly free from the argot that forms the only sort of "conspicuous consumption" to which many scientists can ever hope to attain. There is humor, color, and a wide range of quotation. Long association with affairs of the sea has given the author a vocabulary whose natural and authentic saltiness often serves to flavor a passage that might, otherwise, seem mere nourishment.

To many readers, unquestionably, the most interesting part of the book will be the 212 pages entitled "An Ornithological Circumnavigation of South America." In introducing this section, Doctor Murphy says:

The journey upon which we are embarking has never before been undertaken. I propose to skirt the continental coast line with full disregard of distance, time, and circumstance. Neither weather nor current need retard us; no island of the surrounding seas shall be too remote for us to reach within a twinkling; moreover, we may view the

successive prospects, as preference dictates, either through eyes of today or those of generations long departed. To describe the topography in detail would lead us too far afield. Let us in the main travel fast, halting only to picture a series of well-chosen localities along the ocean front, and at islands offshore. At each such station we may select the time of year best suited to our purpose of observing the bird life or the periodic natural phenomena concerned with the distribution of birds.

Travelogue rich in interest

From the mangrove tangles of the northern coast, where many birds familiar to visitors to southern Florida and the Gulf coast of Texas, are found, the reader is conducted on an idealized Cook's tour that not only touches on every region on the mainland, explaining it in the light of the geographic information that has already been presented, and "lining up" species of birds as week-end observers are wont to do in Bronx County, but the fanciful expedition goes as far a-sea as Ascension and St. Helena islands. In the region of the Straits of Magellan Darwin takes the reader's one hand while Doctor Chapman takes the other. Strange phenomena are reported. At various islands are encountered "rollers," gigantic combers whose origin may lie hundreds of miles away in unknown meteorological disturbances. At Tristan, we are told, the introduced cat was exterminated by the introduced rat!

There are tales here, scientific truths and seaman's yarns, to make one wish to linger—but 27,000 kilometers are long and the entire west coast with its Humboldt Current, and its amazing guano industry, are waiting. Arrived at Panama, we have covered only 322 pages, and 800 remain before us!

This is the portion of the book that treats the birds in detail. One hundred and eighty-three species and subspecies "are more or less formally considered." In the instance of each bird, material is given under the following headings: scientific name and original citation; vernacular name in all languages, including the aboriginal; description and diagnostic characters; eggs; distribution; general word picture; historical and economic status; American Museum specimens and field experiences during Museum expeditions; systematic relationships; place in the South American region; migrations; habitats, with geographic and ecologic correlations; breeding season and be-

havior; relations to other animals, including man; the young; moults; voice; food; enemies and diseases.

Ten species of penguins are thoroughly discussed, and the accounts of the behavior of these highly social birds furnish especially fascinating reading. Little, relatively, is thus far known of the penguin mind and some ornithologist still has before him the engrossing task of making experimental studies of how these birds live, on their breeding grounds.

With various Procellariiformes—albatrosses and petrels—we roam the seven seas. Along the American coast we follow the fortunes of pelicans, boobies, and cormorants. We read Doctor Murphy's solution of the old problem of the steamer ducks, and watch a skua eat its own young because, apparently, it had been prematurely helped from its shell by a watching ornithologist. We read of the incredibly awkward nesting habits of the lovely fairy tern and, finally, encounter a startling suggestion that the black skimmer, a familiar of New Jersey and Long Island waters, does not use its extended lower mandible to scoop up food, but that it serves as a lure—that the bird is a sort of avian Izaak Walton. Of richness and variety there is, here, far too much to be more than hinted at in this review. I can only urge anyone who is interested in the manner of life upon this earth to secure a copy of the book before the edition has been exhausted.

Paintings by Jaques

Sixteen color plates by F. L. Jaques include some of that distinguished artist's most impressive work. In 1925, after a period of work on Barro Colorado island in the Canal Zone, he went to Callao, Peru, to make field sketches. In 1935 he visited the Juan Fernández islands, Valparaíso, San Felix and San Ambrosio islands, Pisco, Peru, the Chincha islands, Hormigas de Afuera, and the Galápagos. Besides his acquaintance with the west coast, his experience in the Arctic stood him in good stead in painting the hard-surfaced waters of the far-southern hemisphere. His extraordinary ability to see, and interpret in color, the quality of light, atmosphere, and sky, has never

been more of an advantage than here. It has often been said of his painting that his landscapes would stand alone—that they do not need the birds that, to a naturalist, make them particularly alive. The wildly dramatic terrain of Tristan da Cunha, South Georgia, Peru, and Falkland Sound are possessed of an austere and colorful beauty that has found his brush responsive. The blue-footed boobies, fairy terns, wandering albatross, kelp goose, and Atlantic petrel seem, to this reviewer, especially fine.

Copiously illustrated

There are a number of maps and charts that are helpful to the reader. One lack the book seems to have, and that is a map giving the names of political subdivisions. Doctor Murphy inevitably refers to them, in his text, and while the small diagrams are useful as one "circumnavigates" the continent, it is bothersome to have to hunt for a small segment of the coast when one desires to locate oneself.

If a serious stricture may be levelled against this book it is, I think, because of the small size of the edition. Only 1200 copies were printed and according to rumor there will not be a second edition. This means that the report on more than two decades of fine work by outstanding scientists, and by collectors who repeatedly risked their lives to secure specimens, will be in the hands of a few fortunate individuals and some of the larger libraries. Those responsible for the printing of these volumes should—and must—realize that such works as this are the very tools of science; Doctor Murphy's text contains so much of zoogeography and life history material that it will be invaluable, for years to come, to ornithologists. Will be? Should be. Ten years from now it will not be available, except at the impossible prices brought by collectors' items. The high cost of printing the first edition can scarcely be sufficient reason; most people to whom this book will appeal would rather pay 50 per cent more now than 150 per cent more a year from now.

The book deserves as high praise for the excellence of its manufacture, as for its writing and illustration.



WINGS OVER WAVES



A selection of eleven color illustrations by Francis L. Jaques, Staff Associate, Department of Arts, Preparation, and Installation, The American Museum of Natural History.

They are from *Oceanic Birds of South America*, two volumes, by Robert Cushman Murphy, of the Department of Ornithology, American Museum.

PUBLISHED BY THE AMERICAN MUSEUM
OF NATURAL HISTORY, NEW YORK, 1936

Fairy Terns and Black Noddies South Trinidad Island

"Most ethereal of sea birds are the delicate and gentle Fairy Terns. Their plumage is white, but with subtle ivory or creamy tones and with a barely perceptible reddish gleam visible in certain lights on the feathers of the belly. The last is all but illusory, and yet I find that most persons can see it if they are asked whether the ventral surfaces of specimens show a bloom of any sort. In the air these terns are ghostly creatures, their exceptionally large black-rimmed eyes sometimes seeming like empty sockets. Moreover, when they fly overhead against the brilliant tropical sky, only the bones and flesh of their filmy wings fully obstruct the light. At such times the Fairy Terns resemble tiny flying skeletons, except that their lightness and grace are more suggestive of disembodied spirits. . . .

"The curiosity of the Fairy Terns is notable, and Meliss . . . states that they are particu-

larly attracted by white objects. They have a way of fluttering just in front of one's face in a manner that soon becomes disagreeable—not attacking, but merely staring, hovering like overgrown mosquitoes, and wheezing in a way to suggest the buzz of some such noxious insect. . . . As I sat in a whaleboat on the heaving swells close against the cliffs of the . . . island, a succession of these birds fluttered just in front of my nose so that I was able to pick them out of the air by hand. After being captured, they made no resistance except for a very mild and brief struggle, and they did not attempt to use their potentially dangerous bills. . . .

"The egg of the Fairy Tern is so precariously balanced on rock or bark, or even in a slight hollow of a smooth and slender branch, that it has often been wondered why more of them do not come to grief. . . .

*Pacific Fairy Tern, to illustrate the translucence of the wings
Ducie Island, southern Polynesia*





King Penguins, South Georgia Island

"With its large size, graceful lines, and golden ornamentation, the King Penguin is one of the handsomest members of its family. Although less impressive in stature and bulk than the Emperor, its dignity of behavior suffers nothing by comparison, while in color pattern it is an even more striking creature. . . .

"Incubating King Penguins can shift about slowly in spite of the egg on their insteps. They drag themselves along, maintaining a hunched posture, and hitching the feet with short steps so that the egg may not roll out. If they chance to trip, or if they are bowled over, they fall as stiffly as a statue, with the egg still in place. . . .

"The sitting Kings are fond of crowding together, as if to facilitate quarreling. . . . When one bird budges, trouble is in store. With the beginning of movement, the adjacent sitters may be seen to glare at each other with sinuous necks twisted and heads cocked, and then to deal resounding whacks with their flippers, or lunges with their sharp bills, unto all their neighbors. Whole groups may become engaged in an indiscriminate skirmish, as if with both rapiers and broadswords . . . only occasionally

is one knocked off its pins. Even then the egg is usually unharmed. Bearing upon this is Wilson's interesting comment: '. . . so tightly were they held that although we lifted the birds bodily from the ground, yet the egg was very seldom dropped.' . . .

". . . Courting couples were often seen strolling off alone, in a most human fashion, and making their way to the tops of hillocks or snowbanks, or even up glaciers. The usual pattern of caresses is for the birds to cross necks and sway from side to side, while facing each other, and then for the cock to step aside and press on his mate's nape until her head is bent quite to the ground. . . .

". . . Quarreling because of triangular complications seems to be invariable in the early stages. . . .

"King Penguins deport themselves in an amusingly 'lofty' manner toward human beings, paying slight attention to a man's quiet intrusion. If they are annoyed, they march slowly and with an air of indifference, until they have been actually frightened by abuse, when they fall upon their breasts and scurry on all fours. . . ."

*King Penguins incubating and quarreling
Bay of Isles, South Georgia, February, 1913*





Guano fowl of the Humboldt Current: Peruvian Pelicans, Boobies, and Cormorants

"In comparison with the spell of the interior, . . . the appeal of the long, shining coast of Peru seems to have been felt by few. . . . Of the extremely profuse wild life of this coastal ocean . . . [the voyager] may chance to observe no more than sea-lions and vast flocks of birds; and if he seeks a traditional product of the waters which can compare in importance with the marvels of the interior, he finds only guano, the ammoniacal smell of which strikes his nostrils whenever the steamer draws into the lee of bird-inhabited islands. . . .

"The bird life, both resident and transient, is the most spectacular feature of the coastal waters. For a characteristic glimpse of it we may call . . . upon the talented pen of Dr. Chapman:

"As for the birds, who can describe them in their incalculable myriads? . . .

"Seaward, like aerial serpents, sinuous files crawled through the air in repeated curves lost in the distance, while low over the water processions passed rapidly, steadily, hour after hour, with rarely a break in their ranks during the entire day. . . .

"But the most amazing maneuver in all this astounding spectacle was the instantaneous disappearance from the air of flocks of 500 to 1,000 Boobies that chanced to pass over a school of fish. Then, as one bird, they plunged seaward and the sky, which a moment before seemed full of rapidly flying birds, was left without a feather. . . . When we left Salaverry late in the afternoon there was no apparent decrease in the numbers or activities of the winged fishers; but I could look at them no longer without a feeling of confusion and dizziness; for the first time in my life I had seen too many birds in one day! . . .

". . . as matters stand today, three species far outweigh all others together as producers of guano at the Peruvian islands. These, in the order of their contemporary importance, and listed under their native as well as their technical names, are the following:

1. Guanay (*Phalacrocorax bougainvillii*)
2. Piquero (*Sula variegata*)
3. Alcatraz (*Pelecanus occidentalis thagus*). . . ."

*Residual stacks of guano at the central Chincha Island, about 1860
The layers are here in excess of 20 meters thick*





Guanays, or Peruvian Cormorants

Santa Rosa Island, Peru

"The Guanay, first in importance among the famous guano birds of Peru, has been called the most valuable bird in the world. . . .

". . . It is a long-winged cormorant, capable of flying strongly for hours against the brisk southerly breezes that blow every afternoon throughout the greater part of its range. . . .

". . . the Guanay is in effect a machine for converting fish into guano. A relatively small proportion of this is deposited upon the islets, where it becomes available for human use; the remainder returns to the sea where, however, it is not 'lost,' for it restores to the water the fertilizer of the marine pasturage. . . . Schweigger, as quoted by Schott . . . has computed that, whereas the people of Peru capture and market annually about 4000 metric tons of fish, the sea birds of the country devour 5,500,000 tons! . . .

". . . dark flocks of guanayes form rafts which can be spied miles away. Slowly the dense masses of birds press along the sea, gobbling up fish in their path, the hinder margins of the rafts continually rising into the air and pouring over the van. . . .

"At other times, when the guanayes are moving toward distant feeding grounds, they travel not in broad flocks but rather as a solid river of birds, which streams in a sharply marked, unbroken column, close above the waves, until an amazed observer is actually wearied as a single formation takes four or five hours to pass a given point. . . .

"Toward evening of . . . October days, most of the guanayes would be courting, after strenuous hours at sea during which all their energies had doubtless been devoted to winning the sustenance of life. Privacy does not enter into their notion of fitness, and while six or seven birds occupy each square yard of ground, the love-making antics are often in full progress. . . . Two guanayes stand side by side, or breast to breast, and ludicrously wave their hands back and forth or gently caress each other's necks. . . .

"Visible actions, rather than unusual sounds, alarm the courting birds . . . the firing of a gun straight into the air produces scarcely a stir provided the weapon is not brandished. The effect of human conversation is, however, most amusing. Whenever a man, sitting perfectly still, begins to talk to the guanayes in a loud voice, a silence falls over all the audience within hearing. Their mumbles and grunts die away, and they listen for a while as if in amazement. . . ."

*A Rock Shag colony. East Island, Falklands
December, 1915*





Peruvian Pelicans Ancón, Peru

"The Peruvian Pelican, or 'Alcatraz,' is by far the biggest and most conspicuous bird to be encountered in flock formation along the desert coast of western South America. It instantly reveals its identity as far as the eye can reach. It is, indeed, one of the world's largest pelicans, exceeding in size even the White Pelican of North America. . . .

"There are reasons for believing that in past times the pelican was an extremely important guano-producer, perhaps even the bird of first rank at many islands along the whole length of the Peruvian coast. Certainly the Incas and their predecessors held it in high regard, as indicated not only by the traditional laws for its protection but also by the preponderant use of the pelican design in . . . artifacts . . .

". . . The pelicans invariably give the impression of being the shyest and stupidest of the guano birds. . . . Before taking flight, they usually open their great bills wide and empty themselves of a bellyful of fish. Sometimes even those soaring overhead express their excitement in the same way, sending down a

fearful rain of anchovies or anchovy paste! . . .

". . . Afloat they seem less timid than while at the nest, and they soon learn to ignore the close proximity of small craft and swimmers. In the smooth water just outside the line of breakers they may often be seen riding sedately, and reaching the bottom life with their long mandibles instead of diving from flight. At times they will also join with other sea birds in hot pursuit of a rapidly moving shoal of anchovies, under which circumstances the pelicans usually swim and scoop instead of plunging. . . .

"Only on the ground, at the moment of leaving it or descending to it, and during performance of the dive, does the pelican lose its grace and dignity. . . . The sighting of fish causes it to apply the brakes, tilt up in front, spread the tail, and tread the air with its feet. The beginning of the plunge may be accelerated by one or two strong wing strokes, after which the bird hurtles headlong, with the wings at least half extended, and strikes the water with a vast, resounding splash. . . ."

Brown Pelicans at the Pearl Islands January, 1935





Piqueros, or Peruvian Boobies Pescadores Island, Peru

"'Piquero' is the Spanish word for lancer, an appropriate appellation for this booby, the spectacular plunges of which are familiar sights throughout the length of the Humboldt Current. It is thrilling to see one bird descend straight from the blue and vanish in a jet of foam which seems to leap to meet it, so swift is the fall. But a Piquero is rarely alone, and the scene of thousands striking the ocean like hissing hailstones is one that beggars description. . . .

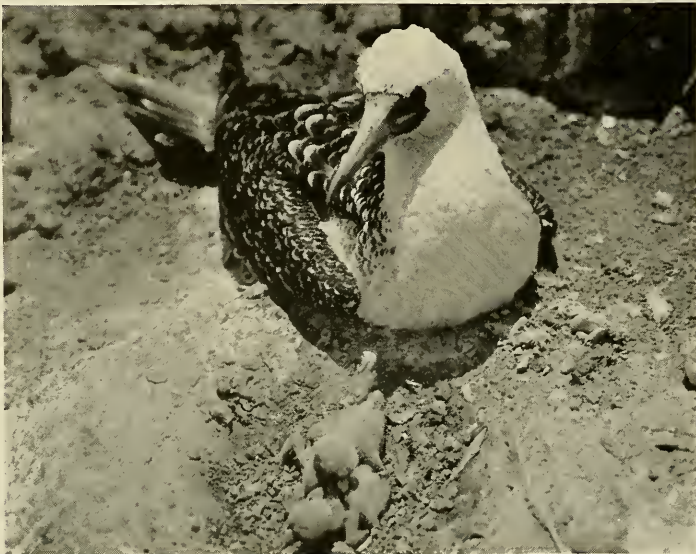
"The Piquero is the most abundant of the guano birds, and, as a producer of available fertilizer, it has undoubtedly won the place of closest rival of the Peruvian Cormorant or Guanay . . . a thousand Piqueros would produce more than ten available metric tons a year, or a million birds 10,000 tons, which might be close to a million dollars' worth. . . .

"I have seen . . . nothing more exquisite than the pantomime of adult Piqueros hanging on the wind above the cliff of Guañape. The innumerable white birds would come sail-

ing up over the nest on the plateau and, when they had reached the brink, the updraft would lift them like kites. Then for minutes they would poise, hardly changing their positions, but twisting their necks to look toward me or to glance at their hopeful chicks below. Some of the graceful, living seaplanes were hardly more than arm's reach from me, and beyond they stretched away until the distant birds seemed like a flurry of snowflakes. . . .

". . . the chicks seem to be rather chummy companions, often stroking or nibbling each other, while making soft grunting sounds. When the parents return, well laden, a considerable stimulation of coaxing seems to be necessary before food is relinquished. The heads of the youngsters then disappear down the gullet of the old bird. Replete chicks are likely to sleep for a while on their sides, curled up like kittens, with the bill tucked under the wings. The return to consciousness and renewed appetite is accompanied by prolonged yawning. . . ."

*Piqueros, Parent and young, south Guañape Island
January, 1920*





AQUIS

Wandering Albatross and Wilson's Petrels and a double circular rainbow sketched by the author in the South Atlantic

A wing-spread of about $11\frac{1}{2}$ feet leaves the albatross in a secure position as king of the air in our modern world.

"By July or August the oldest of the young albatrosses are nearly as large as their parents, and so fat that they are probably every bit as heavy, though still enveloped in an exceedingly dense coat of gray down. Then something happens which is so extraordinary and spectacular that the early accounts of it found little credence, although we know now that it is paralleled in greater or less degree among all Procellariiform birds. With the setting in of the antarctic autumn, the adult albatrosses completely abandon their nestling offspring, not for a matter of days or weeks but forever. . . .

". . . For three months or longer the young albatrosses receive no visits from the adults and subsist entirely without food. Toward the end of this time, they begin at last to amble down off their nests and to try first their legs

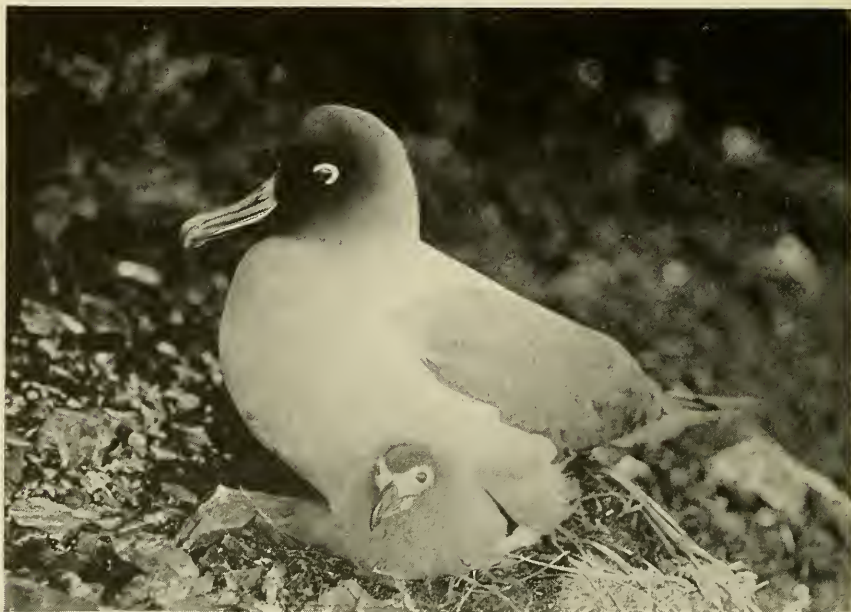
and afterwards their wings. Flight practice involves a long course of what might be called ground-training. . . .

"Wilkins says that . . . the absence of wind brings the adults to grief when they finally come down among the grassy hammocks. At least half of them make a faulty landing, striking the ground violently with their breasts and turning turtle. This usually causes them to vomit their stomach contents, after which they have a very dejected appearance. . . .

"Finally, there are a number of tales, doubtless mostly apocryphal, of men in the water being attacked by Wandering Albatrosses. The only one that seems to be worth citing is the highly circumstantial account by Green . . . of a

". . . sailor who was swooped at by an albatross after falling overboard in 42°S. , 90°E. The man seized the bird by the neck and drowned it, and then used the buoyant body as a float until he was rescued nearly an hour later. . . ."

Male Light-mantled Sooty Albatross brooding its nestling on the ledge of a cliff. Bay of Isles, South Georgia, January, 1913





Peruvian Penguins at the mouth of a sea cave, Independencia Bay

"No sea bird, apparently, surpasses the Peruvian Penguin in exclusive attachment to the Humboldt Current region. . . . Its range is substantially the length of coast line along which the Current is in contact with the continent. . . .

"At the Chincha Islands, in Pisco Bay, Peru, I found during October and November, 1919, several burrows, each containing a pair of adult penguins or one bird covering eggs. All such holes had been dug with difficulty in the sand, pebbles, and fine talus at the junction of a narrow strand and the base of a granitic cliff. . . .

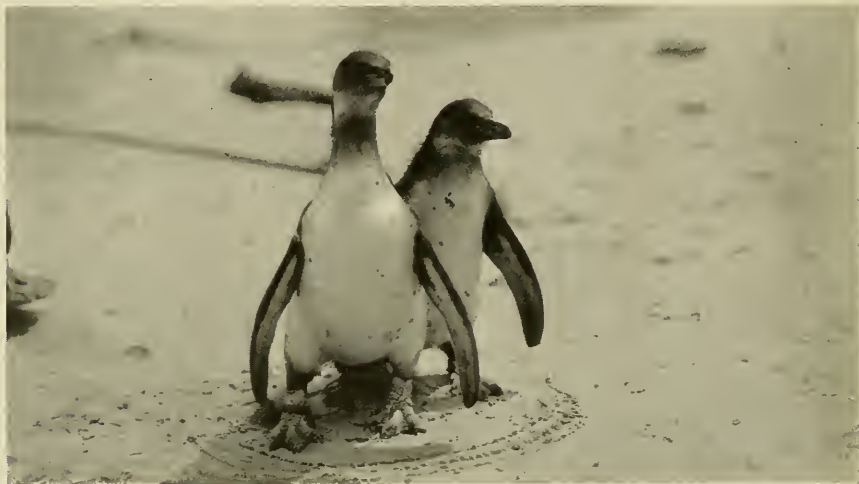
"At Vieja Island, Independencia Bay . . . I found the Peruvian Penguins nesting in burrows, but of a very different type. . . . A high and steep bank behind a shingle beach along the western shore of Independencia Bay was riddled with two horizontal and parallel rows of burrows. The first-floor apartments, so to speak, were underneath a well-marked stratum, half a meter or less in thickness, and about seven meters above the present mean level of the bay. . . . Thirteen meters higher up the bank was a second, similar layer of dark shells

forming, in the same manner as the one below, the roof or ceiling of another tier of penguin burrows. In front of each row of black holes a worn, level promenade, like a porch, had been formed along the face of the silty bank. . . .

"Paessler . . . writes of a fledgling which he caught on the Chilean coast, and which, for the first few days of its confinement, he had to feed forcibly with fish and raw meat. . . . Within a surprisingly short period, however, this captive became reconciled, and began to seek its new source of subsistence. Next, without a struggle, it would allow itself to be tied by the leg, carried down the landing stage, and tossed overboard to catch its own fish. Even when tethered by an eight-meter length of cord, it took plenty of prey, and grew fat. Twice it slipped the line completely, but came back to the steps, nevertheless, and called until it was hauled out of water. . . .

"The Peruvian Penguins often join unwittingly with many other kinds of birds, and with such creatures as bonitos and sea-lions, in pursuing the great shoals of small fish that are so characteristic of the Humboldt Current region. . . ."

*Captive fledgling Peruvian Penguins
Chincha Islands, November, 1919*





Fuegian Oyster-catchers Falkland Sound

"At the Falkland Islands, the type locality of this handsome Oyster-catcher, it is known as the Black and White Curlew. As a matter of fact, its long-drawn wailing cry, which sometimes sounds extremely melancholy as it rings across the moorlands, very much resembles that of the true Curlew in the British Isles. It is shrill and ear-piercing at close range, but plaintive and silvery when heard at a distance. This call is quite different from the steely, rapid-fire note of alarm often uttered. The latter is entirely 'oyster-catcher-like' and when seventy or eighty of the birds are flushed while feeding together, they can make an amazing amount of noise. . . .

"In moments of composure the Fuegian Oyster-catcher may rest upon one leg, with the bill turned back under the wing coverts but with one golden eye kept open for the slightest movement of a watcher, which will send it off again and bring forth a new tirade. The birds spend much time preening and invariably look well-groomed. When they are

angry, they point their wings straight upward and hold them there in the proud manner of skuas. During their breeding season their wide-awakeness is redoubled. . . .

"Cobb states that in the Falklands the eggs are sometimes laid among beach pebbles without any attempt at nest-making, while again nests lined with dry grass are found in the tussock bogs. Once in a while, he goes on, a site may be chosen well inland, among low thickets of the diddle-dee or native heath. Doubtless the commonest type of nests are on the beach, not far above high watermark, but among dry seaweed so speckled with lichens as to show that the water is unlikely to reach it.

"Observations upon the young and their care are scarce. As among other species of oyster-catchers, however, the chicks begin to move about while they are still small; but they are quick to 'freeze' at the sharp signal from the parent birds, and do not stir again until they receive the announcement of 'all clear'. . . ."

*Sheath-bills. Bleaker Island, Falklands
December, 1915*





Belcher's Gull (*with banded tail*) and Kelp Gull, Santa Rosa Island, Peru. The other birds are Peruvian Boobies

Belcher's Gull

"Throughout the guano islands of Peru, the Simeon [as this Gull is locally called] is generally regarded the most serious enemy of the guano-producing birds. . . ."

Kelp Gull

"This handsome black-backed gull, the largest member of its family in South America, has one of the most extensive ranges among sea birds. . . ."

"Distrustfulness seems to be a strongly marked temperamental character of the Kelp Gull. Whenever at South Georgia I was bent upon stalking a sleeping albatross or seal with a camera, and was at the point of accomplishing my object, a self-appointed sentinel in the form of a gull would be almost certain to fly by and to warn my prospective subject with its annoying cackle. But while the gulls would render me no assistance, they were always ready to profit from the slaughter of sea-elephants by members of the crew of the brig 'Daisy.' . . ."

"The Kelp Gull has feeding habits of the most diverse kind, its staples depending very largely upon place and circumstance. Its old mode of life in many places has been changed by human activities, such as those of shore whaling stations and plants for the slaughtering of sheep or cattle. For such reasons, the Kelp Gull is no doubt now vastly more of a scavenger than it was in primitive times. . . ."

"Carrion-feeding is only one step removed from the eating of live stock, and in Patagonia and the Falklands the Kelp Gull is roundly hated because of its attacks upon young lambs. Even dogs and cats go in terror of it about ranch stations. In carrying off eggs or the young of various birds, it is almost as adept as the skua. . . ."

". . . The gulls seem always to be on the alert for the turn of the tide, which will expose their feeding grounds. Hard-shelled creatures, such as they cannot readily break with their bills, they drop from a height in the usual gull manner. . . ."

*Kelp Gulls following a shoal of fish in the Strait of Magellan
November 22, 1914*





Atlantic, or Schlegel's, Petrel off Tristan da Cunha

"Oceanic birds of several groups still belong in greater or lesser degree within a . . . category of uncertainty, but perhaps none so much as . . . members of the Procellariiformes, the order comprising the albatrosses, fulmars, shearwaters, and petrels. Spending most of their lives on the high sea, usually at a distance from the land, these birds are even more essentially pelagic than the penguins. Certain species may abound off any coast, but, unless they are blown ashore by severe storms, or attracted to the littoral waters by peculiar concentration of food, we may be unaware of their existence. While the Procellariiformes are distributed over the salt waters of the globe, they are more numerous in the southern oceans than elsewhere. Here they breed in part at islands so remote or inaccessible that the nesting places of certain species are yet to be discovered. . . .

"That this handsome and extraordinarily abundant petrel should still be so little known is somewhat astonishing. Between the Cape of Good Hope and the neighborhood of the Brazilian coast close to the tropic of Capricorn, and from these latitudes southward to the northern boundary of the Antarctic Zone of surface water, it has been noted by many observers, though collected by few. During my own work in the South Atlantic I logged the species every day, and often in vast numbers. . . .

"Our sailors on the brig 'Daisy' knew the Atlantic Petrel as one of several 'mutton birds,' and we found the skinned bodies of this species to be excellent eating. . . .

"The young stages have never been described, and the only recorded egg, referred to in the text below, is not certainly to be associated with this species."

*A Shoemaker at the entrance to its burrow
South Georgia, November, 1912*







*Courtesy of
Whitby Museum*

Part of old Whitby, the center of the fossil hunter's activities on the Yorkshire coast. The parish church of St. Mary's overlooks the harbor

Among the most plentiful fossils along the Yorkshire coast are the ammonites, an example of which is shown in the photograph at the left. Specimens can be found ranging from half an inch in diameter to over twenty inches. (Photograph about one-fourth actual size)



Staithes, at the northern end of Yorkshire's rich fossil field. Ichthyosaurs and other extinct reptiles have been found in the cliffs to the right; while under the cliffs in the foreground ammonites and other invertebrate remains are abundant

Fossil Hunters' Holiday

Picturesque Yorkshire coast reveals a paradise for the amateur collector. Featuring the ammonite, whose closest living representative is the chambered nautilus

By GEORGE H. RICHARDSON

MANY a person touring England might increase the interest of his trip greatly if he would visit the extraordinary fossil beds of northeastern Yorkshire.

The fifteen-mile stretch of coast between Staithes and Robin Hood Bay, with Whitby as the center, is perhaps one of the most productive fossil beds in the world. It is a veritable paradise for the amateur collector. Glorious beaches and awesome cliffs with thousands of prehistoric specimens invite the traveler to put aside his worries, take up his hammer and bag, and explore to his heart's content.

Life of ancient seas

Ammonites in particular can be found here in abundance, but as will presently be seen, an astonishing variety of other forms are also plentiful. Ammonites are the variety of extinct molluscs which resemble the modern nautilus, the shells being coiled in a flat spiral and divided into chambers. Along this stretch of coast lying fully exposed or partly revealed in nodules are ammonites by the hundreds, measuring from one-fourth of an inch in diameter to more than twenty inches.

Then there are belemnites (fossil cuttlefish) in such profusion that great blocks of shale are covered with them inches deep and one cannot put his fingers down without touching them. Some blocks are literally masses of shells.

A particularly attractive feature of many of the fossils is that they are fully pyritized.

That is to say, they have been converted to a metallic substance, so that they shine with a bronze or brassy luster. Beautiful pyritized lamellibranchs (bivalves, such as the oyster and mussel) and tiny coiled ammonites flash out in the sunlight as if revealing themselves specially for the benefit of the collector. The elongated wedge-shaped pinnae, another kind of bivalve, project in great numbers from the shale as if still alive and partly buried in mud.

Now and then one stumbles on a relic of a much higher form of life. One may find remains of the *Ichthyosaurus*, a gigantic porpoise-like reptile which had four paddle-like limbs and a large head tapering forward into an elongated snout. As the writer saw on his last visit, one may find the whole spinal column and skull of a young ichthyosaur measuring three feet in length. Stranger still, there is a collector at Robin Hood Bay who proudly exhibits the bone of a *Pterodactyl*, a flying reptile.

Dinosaur footprints

At times a fossil fish may be revealed, measuring anywhere from fourteen to twenty-four inches in length, the large scales appearing as though carved out of jet. And at two places as one descends the cliffs one can see footprints of dinosaurs on great blocks of stone. Also there are fossil plants and beautiful leaf impressions in abundance.

At some points one can see blocks of jet, a rich black variety of coal which takes a high polish. The carving of this material has made Whitby famous throughout the world.

The collector will begin his journey from

the famous Old-World town of Whitby. The town is divided into two parts by the river Esk, and the quaint old section is found on the right side of the river. Here stand some ruins dating from the time of the ancient Britons. The streets are not more than four or five feet wide and the principal thoroughfare is so narrow that it is scarcely wide enough for two motor cars to pass each other even though their wheels are on the sidewalks.

Overlooking the ancient town is the old parish church of St. Mary's, built in 1110 A. D., by William de Percy. To reach this historic landmark 199 steps must be climbed. It is approached by way of Church Street, the center of the old town, where the jet is worked and where fossils can be purchased by those who dare not risk the cliffs.

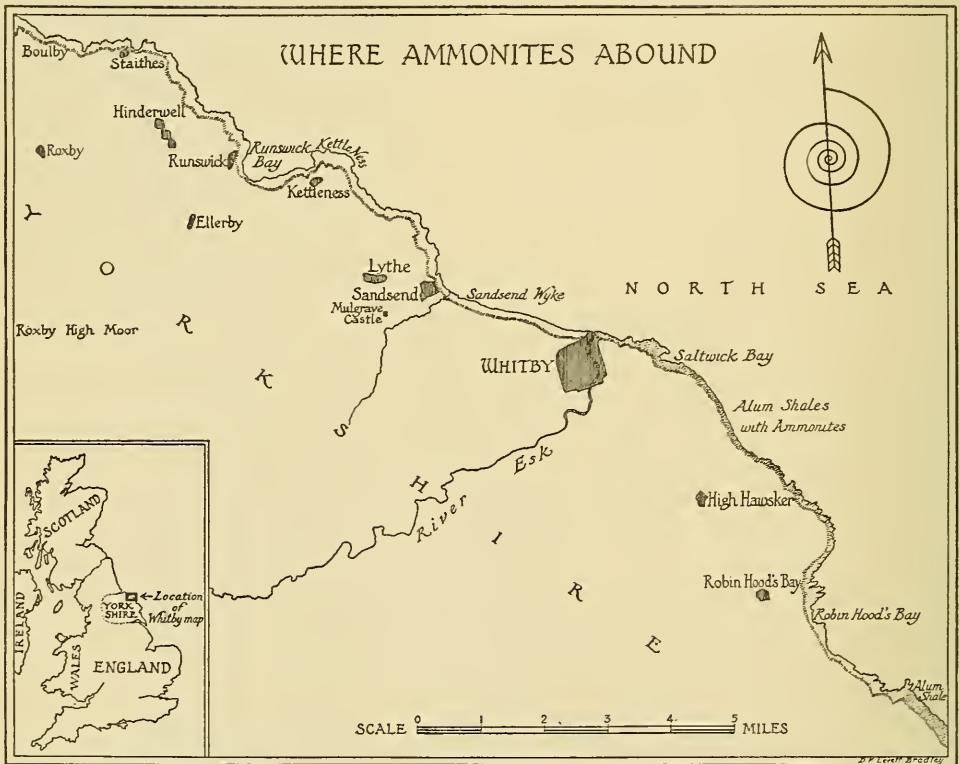
Still higher than the parish church are the famous ruins of St. Hilda's Abbey. The Abbey rose out of the Monastery of Streonshalh,

which was founded by Oswy as the result of a vow in 658 A. D., and was presided over by his daughter Hilda.

According to an old legend, revived by Sir Walter Scott in his *Marmion*, it was St. Hilda who caused the ammonites to occur in this section. She transformed to stone the troublesome snakes infesting the region, after the people had complained to her of their danger and annoyance.

They told how, in their convent cell,
A Saxon princess once did dwell,
The lovely Edelfeld.
And how of thousand snakes, each one
Was changed into a coil of stone
When Holy Hilda prayed.
Themselves within their holy bound
Their stoney folds had often found . . .

Even today the coat of arms of the town of Whitby bears three ammonites, and on traders' tokens of the seventeenth century one can see three ammonites incised.



GLEAMING FOSSILS ARE FOUND HERE

Many of the fossils found along this fifteen-mile stretch of Yorkshire coast shine in the sun like brass or bronze owing to their having been pyritized. This section has supplied the

museums of the world with saurian and invertebrate fossils, and is one of the most picturesque and productive fields in the world for the amateur collector

When the tide makes it impossible for the collector to go on the beaches, he can ramble round this old town which is unique in England, exploring the tiny streets, quaint buildings, jet shops, or the beautiful and helpful museum with its wonderful collection of local fossils, particularly saurians.

Treasure ground of fossils

Going to the bridge which crosses the Esk, the collector can find fossil beds to the north and south as far as Staithes and Robin Hood Bay. If the tide allows, he should follow the beach to both extremities of this fifteen-mile stretch, for every foot of the way is full of geological and palæontological interest.

Beginning at Whitby, he will descend to the beach and walk under the brow of the cliffs on which stands the parish church. Here, where the cliffs reach a height of over two hundred feet, the collector will come to the shale sea floor, and his fossil hunting will begin to bring good results. Whenever he sees a round flattened nodule, he should look on the outside for any signs of ammonites, and if he does not see such signs, he should break the nodule lengthwise, for often the cephalopods are in the middle.

Particularly under the east pier will the opportunities command attention, for at this point of the cliff base the ammonites are very common, as are also belemnites. Oval masses of shale are also common and these should be broken, for invariably they contain shells and belemnites. If one will walk at lowest tide toward the edge of the water, one is likely to find ammonites stripped of all their matrix by action of the tides; many of these are in beautiful condition, not needing any cleaning. Days can be spent on a few yards of these shales and each evening will see the collector return with a full bag.

Proceeding to Staithes, he will encounter at the entrance to the village, if he drives overland from Whitby, one of the steepest hills he ever tried to negotiate. At the bottom of this hill the visitor will come to the "Cod and Lobster," a public house where a youth often sat well into the night listening to tales of the sea, which so fired his imagination that he left his apprenticeship to a grocer and draper, went to sea, and eventually became the famous

Captain Cook. Staithes is still rightly proud of its former apprentice, though the house in which he lived has been altered out of all shape so that one cannot be certain one is looking at the actual building where this youth read and pondered on the life of a sailor.

Nestling in its quiet harbor, this quaint and beautiful spot is a paradise for artists during the summer months, and they can always be seen before their easels. The people here are distinct from all others in Yorkshire, and the carriage of the women as they balance their fish baskets on their heads has often been remarked upon by visitors.

To the north of the village and round the big cliffs saurian remains are likely to be found. Many splendid ichthyosauri have been discovered in the Alum Shales at Boulby cliff, while others have been found to the south of the village. Following the beach to the south of the pier, one is likely to pick up numerous fossils, many of which lie fully exposed without any matrix. Perhaps it is not too much to state that there is not another spot along the English coast where fossils are so numerous. The nodules here are particularly hard and the greatest care is necessary when hammering, for splinters fly off and are apt to cut deeply. More than one eye has been sacrificed at this place because of the flying chips, the great Sedgwick of Cambridge being one of the sufferers.

Colorful fish auction

Always interesting to see, before going down on the beach, is the auctioneer selling the lobster and crab catches of the fishermen. The crustaceans are brought to the quay and thrown down in heaps on sacks where they writhe and crawl while being sold. The pincers of the lobsters are securely tied before they leave the boats, so there is no trouble handling them. To follow the fish auctioneer is quite an education in fish lore, for every kind of fish brought in by the local fishermen is sold on the quay and any person can purchase small or large quantities.

A few miles to the south lies one of the quaintest villages in England, Runswick Bay. How the houses in this village were ever built is always a puzzle to the visitor, but their positions, their tiny but beautiful gardens, finely graded terraces, and red-tiled roofs give the

village a charm one scarcely expects in this work-a-day world.

With a minimum of effort the collector can pick up fossils to his heart's content all along the beach, and particularly at Port Mulgrave, a small hamlet on the way to Runswick Bay.

On our first visit to Port Mulgrave we felt amply rewarded for the awful climb down the hundreds of feet of cliffs to the beach, because it almost seemed as though some person had gathered fossils and thrown them about the beach especially for our benefit. The tide would not permit our walking far on the beach, but there was one stretch where it was possible to collect fossils in spite of the rising waters. In order to reach this we had to go down an exceedingly steep and narrow path with steps cut into the shale cliff by miners years ago, which however are now too badly worn for comfortable walking. At some points the path cannot be seen below, but walking by faith rather than sight we finally reached the bottom. What a glorious time we had there with the fossils.

The first fossil we picked up was a good-sized, magnificent fragment of a very large ammonite fully pyritized and shining like a piece of chased brass. It was beautifully ribbed

and measured ten inches on the outer curve, four inches in depth, and two inches thick.

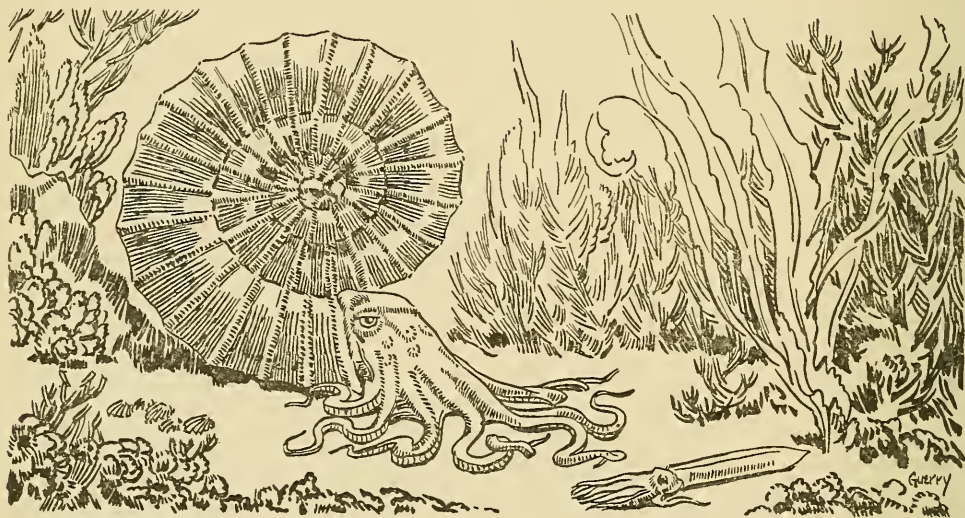
There is a strange thrill in taking out fossils while the tide is coming in and the waves are washing almost to your feet, and it is a thrill one should not seek unless he is certain of a way of escape should the tide rise hurriedly.

All along the coast from Staithes, through Port Mulgrave, Hinderwell, Kettleness, Lythe, and on to Sandsend, there is the most delightful scenery, so that while the scientific interests of the collector are being satisfied, his æsthetic nature is also being fed.

It is quite impossible to give the names of all the fossils found in this part of the coast north of Whitby, but particularly the seeker of invertebrate fossils will have the time of his life.

Returning to Whitby, our collector should proceed at his leisure to Saltwick. We suggest that he follow the upper path on the outward journey, for along it nothing interrupts his view of the sea. As he travels along these towering cliffs, unless his soul and mind are sodden, the sight of the boats, ships, sails, sea-birds, etc., is bound to give him a thrill he will always remember.

Descending the cliffs by a narrow path, the collector will come to a wide-spreading beach



RESTORATION OF GIANT AMMONITE

Lying fully exposed or partly revealed in nodules, specimens of this extinct mollusc can be found along the Yorkshire coast by the hundreds. Cut and polished, the fossilized shells

reveal their separate chambers in a beautiful pattern. The creature in the lower right-hand corner of the picture is a fossil cuttlefish (belemnite)

of shale on which are to be seen great masses of belemnites lying one above the other five and six deep. Some of these beds measure many yards square, while ammonites in abundance peep out of the shale, denuded of practically all their former matrix by tide action.

If the collector is fortunate he is likely to find remains of the prehistoric lizard-like reptiles. Many ichthyosauri, for instance, have been taken out, gigantic fossil reptiles of porpoise-like form. Many of the ichthyosauri measure as much as twenty-five feet in length. These remains are found in the Alum Shales which are well exposed here. Among the saurian relics in the writer's possession from these shales are a part of an ichthyosaur jaw with teeth, and some vertebræ both of ichthyosaur and plesiosaur, the latter being a long-necked marine reptile of Mesozoic times.

A dizzy descent

To the south of Saltwick and under steep cliffs, lie the beaches of Hawsker, but here the tides are especially treacherous and the collector must inquire carefully before venturing forth. There is only one path by which he can ascend from the beach, and this should not be attempted by any whose heart and lungs are not in the very best condition. Finger and toe holds offer the only support the greater part of the way, and the projecting shales are sometimes treacherous. Should one be caught by the tide, he could get out of reach of the water, but it would mean some weary hours before he could find deliverance.

Leaving the beach at the end of the Alum Shales, the collector should take the path leading away from Saltwick. He should keep his eyes open for some large blocks of stone at the left-hand side of the path, for on these are to be seen the footprints of dinosaurs. Following the path through the fields at the top of the cliff, he will come to Hawsker.

At Hawsker, jet has been found for many years and carried into Whitby, the latter town being famous throughout the world for its associations with jet and the manufacture of numerous articles out of this velvet-black mineral. An example of this work stands beside the writer's typewriter, a most beautiful miniature ornamental table made of jet, two and one-half inches high and most wonderfully carved. A

polished ammonite (*A. communis*) is inlaid in the top, showing every chamber perfectly because of the polishing. A number of shops in the old part of the town have their windows filled with objects in jet, many of them glorious works of art, and if one is favored, one can get into the workshops where the jet is polished and carved.

While talking with one of the workers, who was carving a picture of the Abbey in a piece of jet designed for a brooch, we were amazed to notice that he carried on the conversation without ever stopping his work. Without any apparent effort he carved the figure without the tiniest slip. In this man's shop we looked with envy upon a large and magnificent chess-board, perhaps the most unusual one in the world. It is three feet in length by about twenty-two inches in width, and four inches deep, carved out of a mass of jet. The squares are laid out in ivory, and every alternate square is inlaid with beautifully polished ammonite. Around the broad, beveled border Greek mythological figures are carved, and the workmanship is perhaps as fine as any we have seen. The areas at either end are exquisitely carved, and at one end there are three tiny pyritized ammonites from Hawsker forming the insignia of Whitby. One does not hesitate to believe this gentleman when he states that it took four years to carve this marvelous board. No description can adequately reveal the glories of this work of art, but how the soul of a palæontological chess player would rejoice as he vanquished his opponent while playing on such a board.

Found and lost

Soon the jet trade of Whitby will be a thing of the past, for no one is learning the trade today and the supply of jet is becoming less each year. The places once famous for the supply are barren. Occasionally but not often a fall of cliff reveals a mass. A few days before our last visit there was such a fall, and an old jet hunter found a splendid deposit. Taking out sixty pounds' (three hundred dollars) worth, he brought it in to Whitby and sold it to two carvers. Rich beyond his dreams he decided to celebrate his new fortune, and going into a public house he soon became merry in his cups. As the alcohol worked so did his tongue, and

it was not long before he was telling all and sundry of his fortunate find. In spite of the lateness of the hour, his assertion that he had left more than he had brought into Whitby caused some of his listeners to set out with lanterns in search of it. They located the treasure and brought it to Whitby, where they sold it for seventy English pounds. The original discoverer learned of his mistake the next morning when he returned and found the supply gone.

Whereas a few years ago fifteen hundred men and boys were employed in the jet industry, today there are only two men pursuing the carving of jet for the market, and one of these is an old man lamenting the passing glory of that ancient trade.

Glittering fossils

Many of the fossils from Hawsker are fully pyritized, and most of the specimens found by the writer shone like polished brass as they lay exposed on the beach. Whole blocks of hard rocks can be found whose tops are covered with these beautiful fossils.

Continuing on the beach to the south, one finally comes around a boldly projecting cliff and finds himself in Robin Hood Bay. This is even more picturesque than Runswick Bay. Visitors are invariably charmed as they find their way up and down countless steps and walk along streets often not more than four feet wide. It is no exaggeration to state that there are thousands of steps in this little village perched on the cliffs of the bay. Leaving the hotel at the top, one begins the descent to the village down a great flight of steps, past every kind of cottage, and thence to the beach.

Here is a beautiful bay making a complete half-circle, and on its beach the collector can expect to find any kind of Jurassic fossil.

Many of the specimens of ammonites found here likewise have the metallic luster which results from pyritization. A fully exposed one which the writer picked up as soon as he stepped on to the beach on his last visit flashed like a piece of molded brass. Various ammonites are to be found here in abundance (*A. semicostatus*, *raricostatus*, *oxynotus*, *gagasteus*, *capricornus*, *jamesoni*, etc.) ; and, in the shales forming the sea bed, gryphaea, belemnites, and a host of small fossils are to be seen stick-

ing out everywhere. In the shale masses that have fallen from the cliffs, *Pinna folium* is a very common fossil. Many of these are huge in size, and lie as though still alive in the mud. It is no exaggeration to state that in places bivalves and gastropods are as common as pebbles on the shingle.

Someone else's luck

While we were breaking out some ammonites partly exposed in some nodules, and at the same time keeping one eye on some very fine *Pinnae* which we intended to take out of the shale next, a well-known collector came along and unconcernedly announced that he had taken a perfect Pterodactyl bone out of a shale nodule. His unconcern was almost irritating, for we particularly wanted to find bones of the Jurassic period, whereas he was an invertebrate palæontologist. How we would like to have suggested making an exchange, but something in his eye, in spite of his apparent unconcern, warned us that the specimen he had discovered would be his very own for life. Of course, we should have felt exactly the same way if we had found it, but we nevertheless felt that fortune had discriminated against us rather badly. We recalled an experience in the Badlands of South Dakota, when a gentleman from New York found without any difficulty a saber-tooth tiger skull in a small hill to which he had been directed by the owner of a filling station. The owner of the filling station had collected fossils for years and had particularly hunted for such a skull, but without success. Such are the fortunes, or misfortunes, of a fossil-hunter.

This is but the briefest sketch of a subject large enough for a number of books. But when we think of these miles of glorious cliffs and sea beaches which have supplied the museums of the world with saurian and invertebrate fossils, and when we recall those beautiful villages with their whitewashed, red-roofed cottages perched on seemingly perilous cliffs and nestling so beautifully in quiet harbors, it is no exaggeration to say that this fifteen-mile stretch of coast on the northeast of Yorkshire is one of the most fascinating and productive regions of the world for the fossil collector.¹

¹ The reader will thoroughly enjoy *The Official Guide to Whitby*, published by Horne and Son, Ltd., Bridge Street, Whitby, England. 1/—(twenty-five cents).

Color Records of the Badlands

Two artists journey 9000 miles in the interests of science to bring back geological data expressed in terms of light, form, and color

By JOHN AND LOUISE GERMANN

*Staff Artists,
Department of Vertebrate Palaeontology*

THE average museum expedition collects something fairly bulky—such as modern animals, birds, reptiles, or fossil bones. The specimens arrive in the museum at the end of the season in impressively large crates. The expedition we are about to describe came home with a package no larger than a suitcase to represent the season's work.

A picture, according to a Chinese proverb, is worth ten thousand words. Experience has shown that the museum visitor is always quick to appreciate the dramatization of scientific data in terms of light, form, and color. The pictorial method applied to geologic data by means of the new charts just installed in the Osborn Hall of Tertiary Mammals at the American Museum is a practical application of the above principle.

Prehistoric animals plus geology

These new charts were planned to show the relation of the animal types exhibited in the hall to the various Tertiary strata in which their remains were found.

For years this fascinating information was displayed by means of two bleakly conventional diagrams. No visitor gave them more than a passing glance and the real significance of the exhibit as a whole was lost.

The unusual details of the mounted specimens continued, year after year, to draw exclamations of amazement and pleasure, but there was a definite need for some sort of key to give at least a hint of the marvels of evolution, showing not only the orderly march of primitive forms advancing to a final state, con-

trolled by changing climate, but also the survival of adaptable forms and the extinction of others.

Because scenes of classic fossil localities were to form the main attraction of the new charts, it was decided to arrange these scenes centrally, with a column to the right containing pictures of typical animals found in each formation. Wherever possible, the well known Knight restorations were employed. The scale of 1/20 natural size was used for all animals to convey the comparative size throughout.

Charts necessitate expedition

The drawing of the scenes was a simple matter of transferring the pick of many excellent field photographs to canvas. But the color? Confusion! The descriptions furnished by scientists were many and varied. One man remembered colors as seen on a bright day at a distance, another retained impressions of color seen after a rain. Finally, driven to despair, two determined artists told Doctor Granger that their ethics were being badly strained and that they had to see the actual country, at any cost. Doctor Granger took the declaration calmly enough, and admitted that first-hand information is ever the aim of science, but asked on what the artists intended to travel. Promptly a plan was revealed for his consideration. A tried-and-true sedan formed the basis of the scheme, and when this was matched by a leave of absence from museum duties, the expedition was practically under way.

Doctor Andrews' motto "Adventures are a mark of incompetence," became the watchword; and the impressive title "The Germann Badlands Reconnaissance Expedition" was

adopted to cover the scanty equipment hastily gathered for the trip.

Everyone knows that an artist is happiest when depicting atmosphere, color, and form. It is not hard to imagine the eagerness with which we planned this trip. One widely traveled, slightly cynical, but very much amused scientist remarked that there was enough planning going on to carry a truly scientific expedition to the headwaters of the Amazon.

Doctor Granger insisted that we take with us most of the literature on the geology of the region (ten pounds of it including maps). This was stowed away under the other dunnage only to be dug up frantically two weeks later by a couple of artists badly in need of specialized geologic information. Doctor Colbert furnished us with a list of selected localities, sufficient to give a true story of the geology.

The Doctors H. E., F. D., and A. E. Wood furnished road directions sufficiently detailed to land us time and again at a specific scene although, often enough, the location was no more than a small erosional cut in the general center of an all but howling desert. Harold Cook, of Agate Quarry fame, performed the miracle of making clear to us the stratigraphy of the Nebraska Tertiary deposits.

Equipped for rough country

Our painting equipment consisted of sixty canvas panels, thirty pounds of paint, and our sketch boxes. Two light canvas beach chairs with sunshade attachments served as portable studio equipment. A light six foot by eight foot miner's tent, Hudson Bay blankets, a gasoline cook stove, and a railroad lantern formed the bulk of our camping equipment. The car was rigged with a homemade folding shelf bed, which could be extended on the back of the seats—this proved a blessing when sand storms with high winds might have sent us over the prairie chasing a runaway tent. An army engineer compass worn at the belt also saved much time when dust storms wiped out all trails. It will be of interest to Boy Scouts that, due to carefully taken compass bearings, we never were lost for a moment. However, it must be admitted that the places to be sketched were often strangely mislaid—one time for two days!

Four days of travel from the American Museum took us over the Mississippi and into Nebraska. The engine was boiling over and we were in the field at last, in the midst of drought-stricken prairies which reached in all directions as far as the eye could see. Our first port of call, Ainsworth, somewhere ahead, was to be reached by nightfall, over a rough road fenced in with barbed wire. Later, with emergency engine water exhausted, we cheered faintly as we pulled out at last on to hard-surfaced roads.

A wind storm

In Ainsworth we bought straw sombreros and a three-gallon water keg. With these final details attended to we headed for the sand hills south of the Niobrara River. The sun was overcast by dark clouds as we drove down a sandy wash and came out on the level rim of Devil's Gulch. As we unpacked our equipment in the semi-gloom, a strong wind sprang up and with it a whispering noise made by fine dust blowing against sage and yucca. By the time we had eaten supper, the whispering had increased to a shrill whistle. We went to sleep thinking of the significance of the figures showing fractions of a person per square mile given for some of our western states.

The next morning at sunrise we were hard at work on the first sketches of the trip.

Our real initiation in modern badlands running was given us by a local field man. We had returned to Ainsworth after two days at Devil's Gulch completing our sketches. The field man was M. F. Skinner. We accepted his invitation to spend an afternoon with him getting instruction and information for future reference. We started out mildly enough, down the local idea of a surfaced road—but not for long.

"Want to see our old quarry in the canyon?" we heard him say.

Bump! Right off the road diagonally down the side of a ditch, up the other side and right out over the prairie. Then we slowed down to cross an eight-inch cattle trail cutting our path at right angles; a pick-up of speed and soon the car was running in ruts cut in the surface of the prairie. Then another trail joined and the ruts became so deeply worn that the car had to be driven astride, instead of in them. All this at forty miles an hour!

Just as we were becoming accustomed to this startling type of road, we again slowed down to go into second speed and descended a grade, the surface and pitch of which fairly took our breath away. Five minutes of level going and we skidded to a stop on the rim of a cliff with the floor of the valley far below. We had arrived at the Quarry. Once out of the car, we expressed a desire to get a sample of the matrix (the rocks in which the fossils are found). Our guide with a brief "I'll get some for you" literally jumped off the cliff. We rushed to the edge to find that our friend had landed on a huge sand slide and was taking ten-foot steps down to the old quarry hole halfway to the valley floor below. Later in the trip we, also, used this technique to startle a number of newly made friends. We practiced this method of descending cliffs boldly until one day your artist was deceived by a hasty glance over the cliff. Upon landing, he found that he had come into violent contact with a hard clay slope instead of sand. After a hot, fast slide, he landed with most of his breath gone and his pride as a badlands runner badly bruised.

Certain rules were made with a view to keeping the many details of the charts uniform. The most important detail was the direction from which the light would fall on the scenes. As each chart would contain many separate localities, a difference of lighting would prove confusing. At first glance this seems a very simple matter to take care of; however, other requirements of uniformity built up a very nice problem. In the West, midday sunlight is especially intense, so much so that the glare completely robs the country of any definite coloring. This makes it almost impossible to make color notes from about 11:30 to 2 o'clock. The third problem is that of constantly changing shadow patterns. The sun moving calmly through the heavens takes no pity on the draftsman. Shadows are forever shortening or lengthening, and even experience will do little to overcome this difficulty.

Plan of attack

Early in the trip we worked out a mode of procedure which would lengthen our sketching time. Upon arriving at a formation we would scout around to determine a composi-

tion that would best fit into the finished chart proportions, keeping in mind the need for picking the typical coloring in each case. Having determined these factors, we would draw the main outline, block in the general color, and finally paint the shadow pattern, so necessary to show erosional details. Even with this system an occasional two-hour session of work was the best we could attain. The observance of these details caused us to follow a most peculiar schedule at times, and probably did much to strengthen the belief of many local people that artists are queer folk at best. Sunrise often found us in our beach chairs with most of a sketch drawn in. Passing sheep-herders and cowhands could never resist riding over to investigate two beach chairs set up in the midst of nowhere. One cowboy we met near the mouth of Pat O'Hara Creek solemnly informed us that he knew about fossils called dinosaurs, and that he had been told that they had been known to eat cowboys in the old days. Being forewarned about western humor, we gracefully side-stepped the issue and do not know to this day whose leg was being pulled.

A three-day rush

The best example of the schedule we often were forced to adopt, because of light restrictions, was in southwestern Wyoming. This country contains the Bridger Series of geology. Our list called for three sketches: "Bridger A," the earliest in the time scale, buff cliffs, streaked with gray, located at Carter; "Bridger B," central in the series, a ghostly brown, tan, and green-gray formation to be painted at a spot about ten miles from Mountain View; and "Bridger C, D, E," the third location, a series of colorful grays to be painted at a point midway between the towns of Lone-tree and Burnt Fork. The exposure forming "Bridger A" runs north and south with the cliff face toward the west. Adherence to the rule of the light coming from the left meant we would have only three quarters of an hour before sunset in which to work. "Bridger B" was so located that 10:30 to 11:30 would give us the light coming from the left, but also formed the limit before the sun-glare would become so intense that colors could no longer be matched. "Bridger C, D, E" was located for early afternoon painting. Being really a

series of three formations with an additional capping of sandstone "chimneys," it needed all the time we could give it to get a true record. We made a reconnaissance trip and found that our three sketching localities formed a triangle with the town of Lyman near the center. A round trip of this course would involve ninety miles of driving over some fairly steep grades, so we took a cabin at Lyman and unloaded the car enough to insure fairly fast going. Then started a three-day rush.

Cutting corners

In the morning we were off to Mountain View, through the town to the "Bridger B" location. Out of the car to set up the equipment, work until 11:30, then the material reloaded and off for Lonetree. Lunch eaten on the road, one hand for the wheel, the other for the canned tomatoes. Just past Lonetree, out of the car again to paint "C, D, E"; then another loading, and off on the longest leg of the course, Lonetree to Carter, to paint "Bridger A" at sunset. Three days of work finished the series, thanks to a light automobile and a heavy pressure on the accelerator.

The roughest country was encountered toward the end of the expedition. Northeastern Utah contains high mountains, in whose foothills are deeply eroded lands, the high points covered with gravel and the dry washes between deeply filled with fine sand. After locating an area of typical Duchesne River Formation, we tried to find a road that would take us to the far side of the Green River. This jaunt was attempted to save two silver dollars and a lot of time. The regular method of reaching exposures of the Uinta formation would take us back over our route and involve the use of the Ute-run ferry at Ouray. The ferryman would charge a dollar each way if sober, three to five dollars if half-inebriated, and there is no ferry at all when he is fully drunk.

We started from the sketching point on Deadman's Bench, a ridge twenty miles long, taking a trail along the rim of the bench for a few miles, then striking downward and out on the flats, over an endless series of wavelike ridges of red, green, and tan sun-baked clay. As we jounced along, the ridges became sharper and the sand-filled gullies deeper. Re-

peatedly our gas tank scraped as we climbed the far bank in low gear. We kept going, heartened by a lone set of clean-cut auto tracks that wound out challengingly before us. If another car could climb over these slopes we would do the same. The sun was getting hotter and the grades out of the gullies steeper, until finally reason prompted us to examine these lone auto tracks closely and try to read the trail ahead, as did the plainsmen of old, to determine whence came the strange grade-climbing power of this auto we were following. Sure enough, half obscured by the tread marks were the prints of horses hoofs! We had been making our trail-weary auto follow a light team-drawn wagon. The horses were harnessed in such a manner that the following tires obscured the hoof prints as fast as they were made.

A fallen bridge

Our binoculars now showed us, far to the right of our path, a thin green line of trees marking the river we wished to cross. The ground between us and the river being even rougher than that which we had already crossed, we reluctantly turned back. Our gas supply low, we started to back-track and reached our base with an all but empty tank, the bottom brightly scoured by the sand we had ploughed through in each ravine. The walls of these gullies were so steep, and the sand in the bottom so deep, that we were forced to dash at the crossings at full speed in order to make them at all.

The next day we devoted to sketching at Deadman's Bench. We painted by the mid-morning light and so the afternoon found us free to try out a new hunch as to a route to the country back of Ouray without paying two silver dollars. The new direction lay more to the east and the going was fairly smooth with only an occasional drift of fine sand to slow us down. At last, emerging from a low spot in the trail, far ahead of us loomed the banded purple, pink, and gray Uinta country. But, alas, our joy was short lived—a deep gully barred our way. The bridge that should have been there was missing. Yes, it had fallen in and no one wanted to use it badly enough to rebuild it. This would have been difficult under any circumstances, but was made more so here since most of the remains of the old

bridge had been taken away for fuel. The failing light turned us back toward our base again. The next morning found us heading for Ouray not only willing, but eager to pay the Ute ferryman two silver dollars!

In order to attend to the many details so necessary for scientific accuracy in the short time at our disposal, we divided the main points to be covered between us. One artist painted each scene with special reference to composition, while the other concentrated on the proportional widths of color bands and erosional details. To give our studies further authenticity we painted as though a test were being given in a classroom. The sketch boxes were turned so that the canvases were hidden, and comparisons were made only when the work was finished.

Forty-six sketches

Due to the drought conditions of 1934, all sketches were made from perfectly dry formations, doing away with any chance variation in color intensity. Altogether we had time to do forty-six sketches of twenty-four forma-

tions in five general Tertiary regions of the west, the Big Horn, Bridger, Wind River, and Uinta Basins and the Great Plains area. Nine thousand miles of driving and sketching in the eleven weeks allotted, and we were back in the East, unpacking the car and literally shaking the dust of the West from ourselves and equipment.

Colorful memories

Long after the sharper details of the trip have faded we will retain the memory of those all too brief weeks—day by day wandering through cattle ranges, along parallel wagon ruts that wound in and out through sage brush prairie, along rim rock, down through the breaks and out on the flats where the heated air made the landscape wave and flow like an underwater world. No record could truly tell of this world of wine reds, green grays, and vivid yellows that custom designates as our Tertiary badlands.

This is the country which we have tried to bring home to the visitors of our Museum in these four charts.



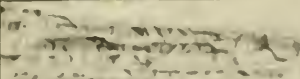

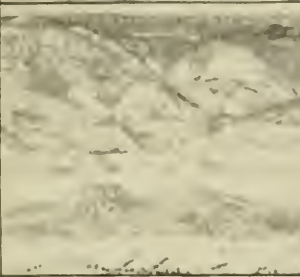








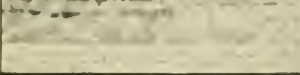



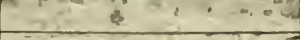

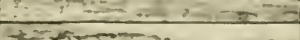

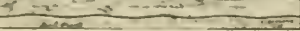



(Left) Green River ferry run by Ute Indian—the route that the artists had to take after encountering a fallen bridge

(Right) The transportation unit of the Hermann Badlands Reconnaissance Expedition. Sixty canvas panels, thirty pounds of paint, ten pounds of geological literature, and camping equipment comprised their luggage



COMPOSITE SECTION OF THE PALEOCENE
EOCENE DEPOSITS OF NORTH AMERICA

B R I O G E R	OSCHERNE RIVER		
	UINTA C		
	UINTA B		
	A		
	D		
	C		
	B		
	A		
	WIND RIVER	LOST CABIN	
	WIND RIVER	LYSIE	
W A S A T C H	GRAY BULL		
	CLARK FORK		
	TEFFANY		
	TORREJON		
	PUERCO		

Color Record

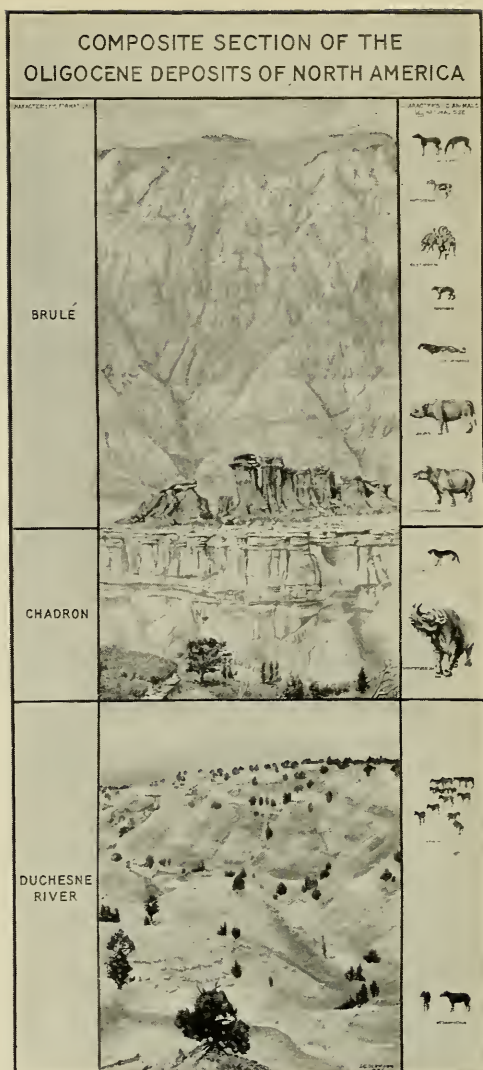
The unusual charts shown here and on the following pages represent a new attempt to show the relation between pre-historic animals and the rocks which yield their remains. Recently installed in the Osborn Hall of Tertiary Mammals at the American Museum, they are the work of John C. Germann

(Below) Fantastic shapes rising like ghostly castles out of the prairie—a scene along the artists' route



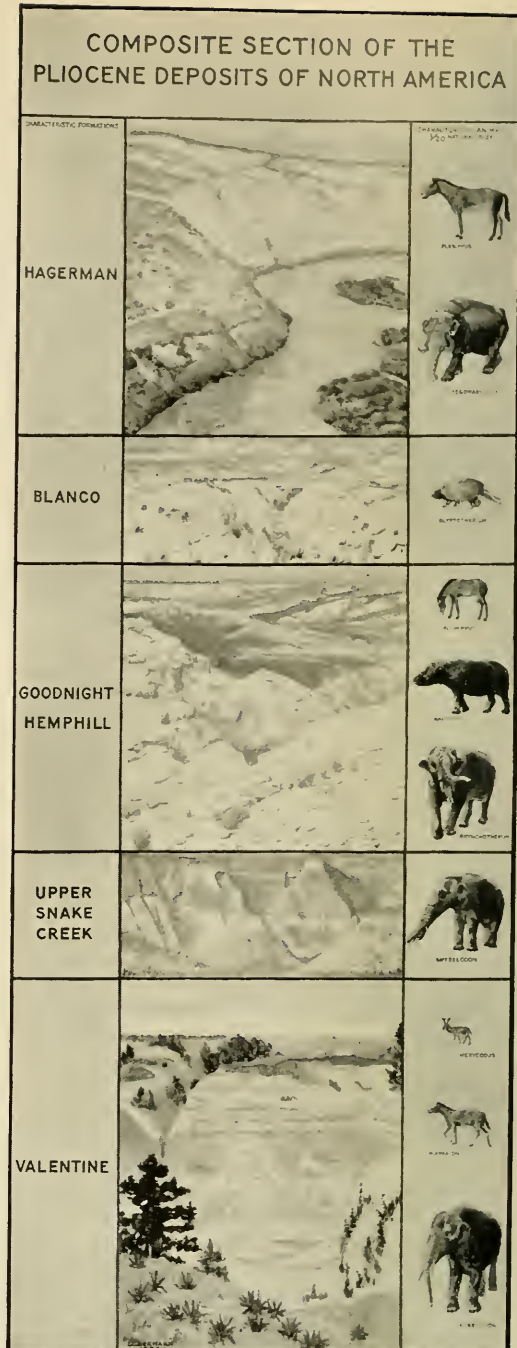
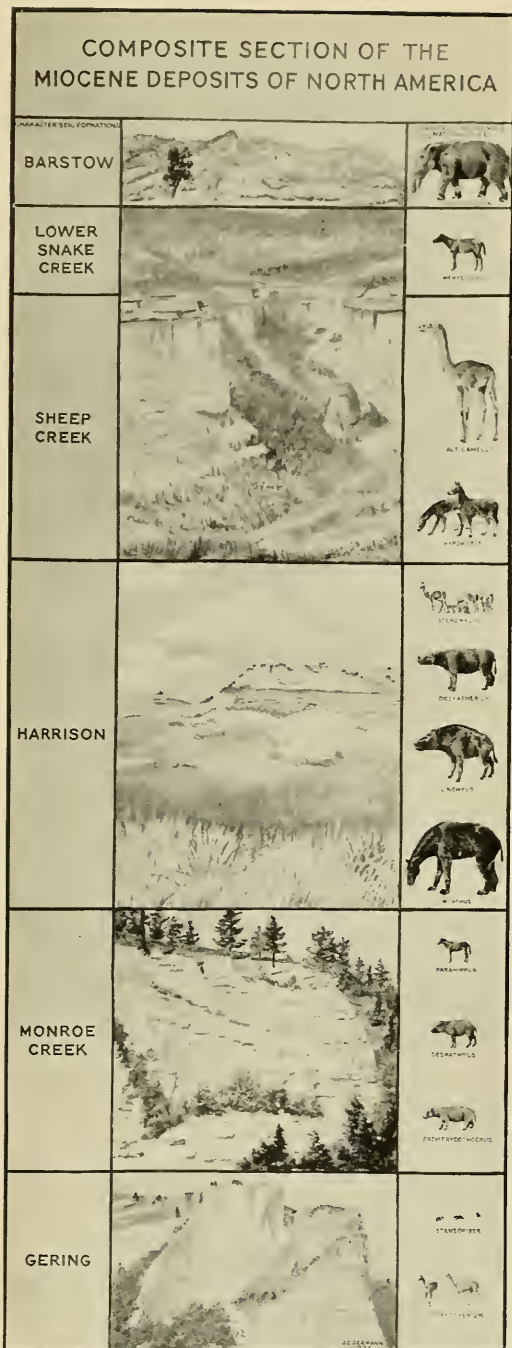
the Badlands

The artists traveled 9000 miles in a "tried-and-true sedan" to get authentic color records of the Badlands. The charts show the orderly march of animals from the primitive types to the more highly evolved. The period of time covered by the four charts is about 60,000,000 years



(Below) Sheep Mountain near Scenic, South Dakota, chosen to represent the Brulé formation





Eighteen million years of evolution are compressed into the above two charts. The animal forms include mastodons of varied types, the extraordinary clawed ungulate *Moropus*, three-toed and one-toed horses, and a variety of camels small and large. The most recent animal represented on the charts is *Plesippus*,

shown in the upper right-hand corner, a near ancestor of the modern horse. About 2,000,000 years have elapsed since this animal walked the earth, a time comprising the Glacial Period, with its advances and meltings of the ice, during which the fauna has evolved into the modern familiar forms

sions of the periods represented. At the extreme left the time scale is given. The diagram reproduced below goes with the Pliocene chart shown on the preceding page

[illegible]

A black and white photograph of a large, eroded sandstone cliff face, likely a butte or mesa. The cliff shows distinct horizontal sedimentary layers. The foreground is rocky and uneven, with some small trees and shrubs. The background is a flat, open landscape under a clear sky.

A Fish That Made History

William Forster's Burnett salmon—a strange Australian fish that led naturalists to a surprising adventure in evolution

By WILLY LEY

AT THE entrance to the Hall of Ocean Life in the American Museum of Natural History a group of exceedingly queer fish may attract the visitor's attention. These fish are mounted in a false aquarium in such a manner as to appear to be swimming near the surface of the water. But the feature of the exhibit that will perhaps catch the eye of anyone who knows his natural history is the fact that one of the fish is resting with its snout protruding above the surface of the water. This posture was not introduced into the group merely by chance. It illustrates a habitual practice of this fish. The fish is not in quest of food but of air. The Australian lung-fish, for such is the type, comes to the surface about every hour to renew the air in its lung.

Romance in science

The story of this fish begins almost like a Jules Verne novel.

In 1869 an Australian squatter, Mr. William Forster, who had lived for a number of years on a farm near the Burnett River in Queensland, moved to Sydney and settled there. Looking over the city which was to be his home, one day he visited the Museum of Natural History and there met the curator of the museum, Gerard Krefft. They became engaged in conversation, and Mr. Forster asked the curator why the museum did not exhibit a certain big fish from the Burnett River with which he was familiar.

Gerard Krefft did not understand the question.

"What big fish?" he asked.

"Well, the farmers around there call it the Burnett salmon, or something like that," replied the squatter, "and the natives call it *Barramundi* or *Barramunda*."

Threshold of discovery

Krefft was not familiar with these words and asked for a specific description. Forster described the fish as well as he could, and Krefft concluded that he had not had the pleasure of making the acquaintance of this strange creature; indeed, that it was probably unknown to science. Forster promised to try to secure specimens of it, and wrote to his cousin, who still lived at the farm near the Burnett River.

The cousin granted his wish, and a few weeks later a barrel arrived at the museum, containing a few specimens of "*Barramundi*," salted well to prevent the Australian heat from doing too much harm to his gift.

Krefft took the fish out of the barrel. It was a big fish—so much was sure. About five feet long it stretched, with comparatively large scales of greenish color and with several very pronounced features. The tail, for example, was not the forked tail of regular fishes, nor was it a tail of the kind sharks have. It was a so-called diphyceral tail: simply a rim of fin material around the end of the spine, difficult to describe but easy to remember once seen. The pectoral fins of the new fish which Krefft was to describe for science were most extraordinary, too, for they were more paddle-like than the fins of any other living fish then known.

But then the great surprise came—a surprise that might almost be compared to the surprise a scientist would experience if he opened a shipment supposed to contain Australian kangaroos and found among them a surviving dinosaur. Krefft opened the mouth of the new fish and looked at its teeth—they were an exact replica of the teeth of fossil fishes that had been found in a very old geological formation.

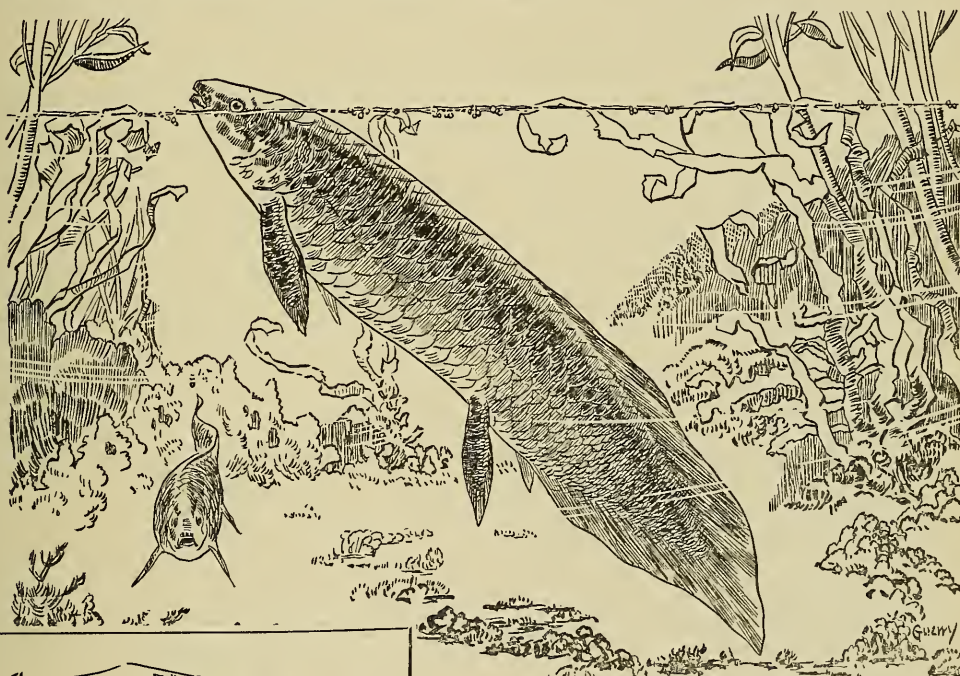
Everything pointed to the fact that the strange new fish from the Burnett River was a survival of a very primitive type from the middle ages of fish history.

Before the fish from the Burnett River had been discovered, the fossil teeth which show a relationship with it caused some perplexity among scientists. It was at first suggested that they were the dental apparatus of fossil sharks; then it seemed more probable that they had belonged to a relative of our sturgeon,

although the latter has no teeth at all. The great authority Agassiz christened the unknown fossil fish possessing these teeth *Ceratodus*, meaning the “horn-toothed one.”

Krefft realized that the teeth of the fish from the Burnett River were so similar to the teeth of the fossil fish that he did not dare to give a new name to the new fish, but applied the same name that its distant relative bore, *Ceratodus*. The specific name, *forsteri*, was given in honor of the original discoverer. And when the name of the scientific discoverer Krefft is included, the designation becomes *Ceratodus forsteri* Krefft. The names *Neoceratodus* and *Epiceratodus* have also been used to distinguish the recent fish from the fossil *Ceratodus*; and the question of generic distinctions has caused some confusion.¹

¹Heber A. Longman discusses the nomenclature in *Memoirs of the Queensland Museum*, Vol. IX, part II, page 168.



AUSTRALIAN LUNGFISH

An Australian squatter discovered this strange fish which breathes both air and water. Gerard Krefft of the museum in Sydney recognized the fish's teeth (indicated at left by arrow) as a replica of fossil teeth from a very old geological formation. Subsequent study showed that it had evolved in the direction of land animals without becoming one of them

The common name "lungfish" refers to the fact that *Ceratodus* possesses a lung besides its gills. Interesting and important as this may be, it has to be noted that the teeth are a far more important feature, so that the admittedly difficult scientific name of this creature is much more descriptive. There is only *one* fish with archaic teeth like *Ceratodus*, whereas there are three fishes known that have lungs. All of them, of course, are reminders of forgotten ages and have rightly been termed "living fossils."

Gerard Krefft, curator of the Museum of Sydney, knew all these things, as far as they were known in 1869. He knew that two different lungfishes were already known. Lungfish No. 1 had been discovered in 1833 by the Austrian collector Johann Natterer in South America. It looked like a fat eel, was about two feet long, and showed a pair of lungs aside from its gills, both organs fully able to function. The natives called the creature *Caramuru*; Natterer invented the scientific name *Lepidosiren* for it. Lungfish No. 2 had been found a few years later in the White Nile in Africa. It looked very much like *Lepidosiren*. The native name was *Comtok*; the scientific name became *Protopterus*.

Scientists wondered

Both of these forms caused annoyance among zoölogists before Darwin's time. True, they chiefly resembled fishes, but if they were placed among the fishes in the systems of classification, it was hard to see what should be agreed upon as distinguishing amphibians (frogs, salamanders, etc.) from fishes. Here were fish that had lungs. According to the old criterion this placed them above fishes. But they could not be placed among the amphibians either, because they had scales. The third alternative was to classify them with the scaly reptiles, but this was impossible because the lungfish had gills.

Actually these two lungfish illustrated the evolutionary process by which the power to breathe air instead of water was developed. Nothing like *Lepidosiren* or *Protopterus* had at that time ever been found in a fossil state, and the great drawback to an understanding of their true significance was the fact that the very idea of convergent evolution had at that time not yet been developed.

Then *Ceratodus* was discovered, the third and largest lungfish, growing to a length of almost six feet in its largest specimens. It had a lung; at the same time its other features proved that it was of vast age. Most important of all, its teeth had already been found in a fossil state.

Lungfish and evolution

This fish was discovered in Australia just ten years after the publication of Darwin's *Origin of Species*; and the story of it is closely connected with Haeckel's name. Following Darwin's principles, the great professor of Jena had been the first to construct "family trees" to show the evolutionary story. This was an entirely new procedure, and much in these trees was, of course, only theory or conjecture. There were gaps where the branches of Haeckel's tree forked into two lines of evolution. It could only be hoped that these gaps might be filled in with animal forms, alive or fossil.

However, there was a principle emphasized by Haeckel which in the absence of fossil specimens, became of value here. This was the biogenetic rule. This rule enables zoölogists by studying the growth and development of an animal in the embryonic state, to learn certain things about the evolution of its species. The rule states that "ontogenesis repeats phylogenesis," in other words that the individual development reenacts, in much more rapid sequence, the evolution throughout the geologic ages.

Haeckel was not the discoverer of the biogenetic rule, but it is closely identified with him. So greatly did he popularize it that for a time every schoolboy in Europe knew these terms, even before they were introduced in school. More recently it has been learned that this rule is not so simple or comprehensive as it was then thought to be. But it remains an important principle in biology; and in the case of the Australian lungfish, as elsewhere, it provided the incentive for valuable research.

Because of his emphasis on the biogenetic rule, Haeckel in particular was eager to learn more about the development of the lungfish. The zoölogy books did not yield much information. *Ceratodus*, they said, is called *Barramundi* or *Barramunda* by the natives; it lives in Queensland in brackish water; it feeds

on water plants, and buries itself in the mud during the hot and dry months of the year. The latter fact was not really known, but it applied to *Lepidosiren* and *Protopterus* and was believed to be true also of *Ceratodus*. It was known with certainty, however, that *Ceratodus* laid eggs; and herein lay the important research problem.

A fish with a secret past

One of Haeckel's pupils, Prof. Richard Semon, was willing to make a special trip to Australia to investigate *Ceratodus*. And a manufacturer in Basel in Switzerland, Paul von Ritter, who had often donated large sums of money for Haeckel's scientific work was willing to pay the expenses of the expedition. So Semon set out for Australia to hunt *Ceratodus*, in order to study its development from the egg.

In August, 1891, he arrived in the country of the "living fossils." The books said that *Ceratodus* preferred brackish water, and therefore most probably would be found where the Burnett and Mary rivers flowed into the Pacific Ocean near the city of Maryborough. So Semon went to Maryborough.

The first letter Semon wrote home related his discovery that *Ceratodus* lives only in fresh water, a fact which necessitated his going inland to find it. His next stop was the little village of Gayndah on the Burnett River. This place was somewhat more promising from a zoological point of view: a specimen of *Ceratodus* had even been recently caught. But better opportunities lay beyond; and besides, Semon was anxious to escape from well-meaning but bothersome reporters and from the other guests of the Gayndah Club Hotel. So he went still farther inland.

Ten years earlier an Australian scientist, Doctor Caldwell (the same who discovered that *Ornithorhynchus* lays eggs) had tried to investigate the development of *Ceratodus*. He had not been successful but he had announced that the eggs of *Ceratodus* were laid on water plants. This was about the only true thing published about the mode of life of *Ceratodus*. Semon was to find out that all that Kreffit had published—aside from the very correct anatomical description—was wrong. *Ceratodus* lived only in fresh water, in the Burnett and Mary rivers. It did not feed on plants,

but on small animals of all kinds, and it did not sleep over the summer in a mud cake like *Protopterus*. Eventually, it was discovered that even the name *Barramundi*¹ was wrong—the native word for the fish was *dyelleh*.

While Semon was busy hunting *Ceratodus* eggs, a visitor arrived—Professor Spencer, biologist from Melbourne, spending his vacation on research. Object: the evolution of *Ceratodus*! The two scientists shook hands and tried to work together—but without success. There was nothing to work on, no *Ceratodus* eggs. Eventually Professor Spencer's vacation ended and he had to return to Melbourne.

A full month later three eggs were found; Semon ordered at once a thorough investigation of every plant in the river. The first day brought twenty-three eggs. Then for several days new material continued to come in, and the real job began, that of watching the development of the embryos in the eggs and putting them in alcohol at the right time in order to have a series of prepared specimens in all stages of development. But soon the supply of fresh material ceased. Semon found the reason for this interruption of his work. Though he had forbidden it strictly, the natives had been catching *ceratodi* to eat them and the one female fish which had produced all the eggs had also become a victim of native appetite.

A serious delay

This little accident delayed the work for a full year. One morning Professor Semon found himself alone, the natives had left their jobs without giving notice. And the rainy period was beginning. The time at Semon's disposal for his Australian adventure was three-quarters gone. He went to Thursday Island, halfway between Australia and New Zealand, where there were a few smaller zoological observations to be made. In the main task he had failed—what was to be done? Go home with very little to show? Or wait for the next opportunity, which would be September of the following year?

Semon decided to wait. Cables from Europe assured him that his vacation would be extended for this purpose. In July of the fol-

¹The real *Barramundi* (*Scleropages leichhardti*) does not live in the Burnett River.

lowing year, he returned to Gayndah and hired other natives, who to his surprise and delight followed his orders and left *Ceratodus* alone. But they required high pay—twenty-five dollars for the first eggs.

On September 16, 1892, eggs were brought, paid for, and the money was exchanged for alcohol. Luck was much better this year, and the collecting went ahead apace. In all, about seven hundred eggs were secured.

The breeding presented no difficulties either; but after a while it became evident that the growth of the young fishes was too slow for the amount of time that was still at Semon's disposal. He had to think about going home. Friends and colleagues promised to care for the young and to embalm specimens in alcohol at the various stages of development.

Once again ceratodi were shipped to a museum in kegs and barrels, but this time the museum was in Jena and the young ceratodi were preserved in a scientific way. Semon was able now to work out his observations and notes and studies, and did it with classic German thoroughness. All the important facts on the development of this fish from the egg are contained in Semon's work, and if a great drought in Queensland were to bring *Ceratodus* to extinction, it would now be a bearable loss from the purely scientific standpoint. Later, the whole evolution of *Ceratodus* through the geological periods became known through the studies of Louis Dollo and others.

A "living fossil"

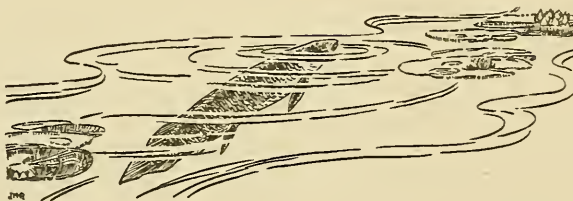
Forster's "big fish from the Burnett River" was one of the great zoölogical finds of the century. It represented the purest type of the original lungfish, while *Lepidosiren* and *Protopterus* had changed considerably in the intervening period of more than 200 million

years. *Ceratodus* exhibits features which indicate a common ancestry with the amphibians, which were the first back-boned animals to live on land; and in certain respects it resembles the salamanders, which are of the latter division. Though the Australian lungfish is not directly ancestral to the amphibians, it is an ancient form that has evolved in their direction.

This was the most important result of Semon's Australian expedition. The other facts revealed about *Ceratodus* were mostly corrections of the wrong notions that had found their way into all natural history books from the first narratives. They have been discussed already, and only one other thing about the lungfish need be said.

High but not dry

Ceratodus, unlike the two other lungfishes, has only one lung, which is somewhat less developed than the lungs of the other two. The Australian lungfish cannot live on land as had been claimed. It is essential that its gills be kept wet. But when in the Australian summer the rivers evaporate until only a chain of small lakes and puddles is left and all inhabitants of the water are collected in them, *Ceratodus* is able to survive. Often many of the true fishes die in these periods because the water soon becomes foul and unbreathable. *Ceratodus*, however, needs only moisture on its gills, no matter how small the oxygen content is, and then is able to breathe atmospheric air by means of its lung. In fact, even in aquariums where the water is perfectly fresh and rich in oxygen, *Ceratodus* comes to the surface about every hour to renew the air in its lung. In this respect, too, it represents an intermediate stage, for even the amphibians breathe water or air; *Ceratodus* always breathes water and air.



Science in the Field and in the Laboratory

Exploration, Astronomy, Broadcasts, Lectures, Field Study, Fishes, Crystals

Edited by A. KATHERINE BERGER

*Mrs. Mary L. Jobe Akeley
Returns from Africa*

Dr. Mary L. Jobe Akeley, wife of the late Carl Akeley, African explorer and naturalist, has just returned from a seven months' expedition in Africa. She made a comprehensive survey of the wild life in the great game preserves of the Kruger National Park, Transvaal, in Northern Zululand, Natal, and also in Portuguese East Africa, for the Akeley African Hall of the American Museum of Natural History which is to be opened to the public sometime this year.

Mrs. Akeley spent two months in studying the Swazi peoples, who are still among the most primitive of the Bantu in South Africa. She attended many of their feasts and ceremonials in the Royal Kraals, and found the natives quite willing to have her learn of their customs and manner of living. The native King, Sobhuza II, was particularly interested in her photographs of the animal groups in Akeley African Hall and her description of the methods of mounting the animals in the American Museum in lifelike attitudes. Besides securing many beautiful pieces of primitive wood carving, weaving, and pottery, Mrs. Akeley also brought back a complete miniature Swazi village especially constructed for her by skillful native chiefs and corresponding in every detail to their kraals or villages. It required nine weeks of steady work for two men to build this miniature village for her. These Swazi huts are constructed of coarse grass and reeds, and young saplings. The miniature village later will be placed on exhibition in the African Hall.

Mrs. Akeley was successful in securing excellent motion pictures of some of the rarest of the animals of this part of Africa, among which are the greater koodoo, sable antelope, stembok, oribi, and blesbok, as well as unusual photographs of lions. In addition she filmed both leopards and cheetahs—animals extremely difficult to photograph because they are rarely seen in daytime. Mrs. Akeley also made a journey into the dense swamps of Portuguese East Africa where live the great elephant herds. In one

herd she found thirty newly born youngsters not yet able to travel through the swamps. The females and young were guarded by two old bulls which stood on the alert in front and back of the herd and trumpeted loudly as soon as they got the wind of the Akeley party. Both herd and party stampeded.

In South Africa Mrs. Akeley found the most remarkable examples of conservation she had witnessed anywhere on the continent. In the Kruger National Park and in the Hluhluwe game reserves the animals, since their protection, have quadrupled in numbers in a period of about twenty to twenty-five years. One notable private reserve is on the estate of General Smuts, who is one of the most ardent wild life conservationists. Here Mrs. Akeley was a guest for several days and trekked over the mountains and plains with the General and photographed his herds of wild game.

On her expedition Mrs. Akeley received the greatest assistance from the Prime Minister of South Africa, General Hertzog, as well as from General Smuts, in securing special permits for her work.

Mrs. Akeley says that she has never seen elsewhere anything to equal the beauty of the flora in the South African spring and summer, and nothing to compare with the hospitality of its people.

In a future issue of NATURAL HISTORY the story of Mrs. Akeley's African Expedition will be graphically described.

Planetarium Demonstrations for Schools

In order to have a closer correlation between the lectures in the planetarium and the courses of study for the respective grades, the Hayden Planetarium staff is giving, during the spring term, a special series of astronomical talks and demonstrations adapted to school needs. The program is as follows:

	GRADES
March 23-27	4, 5
March 30 to	
April 7	7, 8
April 20-24	4, 5, 7, 8
April 27 to	
May 1	6, 7, 8
May 4-8	5, 6, 7, 8
May 11-15	4, 5, 7, 8
May 18-22	6, 7, 8
May 25-29	5, 6, 7, 8
June 2-5	4, 5, 6, 7, 8

While the particular subject of the lecture will be stressed, there also will be sufficient general astronomical information to interest any class or grade.

The free showings are reserved for classes from the public schools, the free parochial schools, and the municipal colleges—all within Greater New York.

The lectures are given at 10 A.M. and 1 P.M., Mondays to Fridays, inclusive.

The Hayden Planetarium

During the month of April the lecture given at all public performances in the Hayden Planetarium will be on the subject of "The Southern Cross," dealing with the southern constellations and individual objects in the southern sky. The April lecture, as is true each month, will begin on the first Sunday of the month, April 5. At each performance during the week from Palm Sunday, April 5, to Easter Sunday, April 12, a brief demonstration will take place at the beginning of the lecture, showing the way in which the date of Easter is determined each year.

Amateur Astronomers Association

During the month of April the Amateur Astronomers Association will hold its regular meetings on the first and third Wednesday of the month, at 8:15 P.M., in the large auditorium of the American Museum of Natural History. All those interested are most cordially invited to attend.

April 1—Dr. John C. Duncan, of Wellesley College, will speak on a subject to be announced later.

April 16—Mrs. Emily Ford Russell will speak on "Romance of the Zodiac."

Educational Broadcasts and Tours

The program for the American Museum Educational Broadcasts and Tours over WNYC during April is as follows:

April 2—When Birds Travel; April 9—Dog Heroes; April 16—The Antiquity of Astronomy; April 23—The Celestial Sphere; April 30—The Solar System.

These broadcasts are given on Thursdays at 5:30 P.M. and the tour time is announced over the radio. The Radio Tour Group meets in the main foyer of the Museum.

American Museum Lectures

For the month of April the following lectures are scheduled:

MEMBERS: Thursday evening April 9, at 8:15 o'clock, "To Shigatse and Lhasa in the Land of the Lamas."

PUBLIC MOTION PICTURES: Saturdays, at 2:00 o'clock, April 4, "Simba"; April 11, "Peoples of Arabia and Africa"; April 18, "Hopi Indians of the Southwest"; April 25, "Eve of the Revolution."

CULTURAL APPRECIATION OF GEMS: By Herbert P. Whitlock, Saturdays, at 4:00 o'clock; April 4, "Chinese Carving in Jade and in other Decorative Stones"; April 11, "Russian Carving in the Decorative Stones and Japanese Carving in Ivory."

SCHOOL CHILDREN: Fridays at 10:30 o'clock; April 3, "The Story of Transportation"; April 24, "Fur Trading in American History."

Schedules for other spring lectures have already been published in the February issue of NATURAL HISTORY.

Field Course in Natural History

The Field Course in Natural History which was sponsored by the American Museum last year was so successful that it has been decided to repeat it this year. The course will be given by Miss Farida A. Wiley, staff assistant in the department of education of the American Museum of Natural History, and Mr. George T. Hastings, chairman of the biology department of Theodore Roosevelt High School. Miss Wiley has directed courses in nature study for New York City teachers for several years. Mr. Hastings has been on the staffs of several camps and has given field courses for teachers. Both Miss Wiley and Mr. Hastings are on the staff of Pennsylvania State College Nature Camp. Headquarters for the course are at the State Institute for Applied Agriculture at Farmingdale, Long Island. Near by are the Cold Spring Harbor Laboratories, Roosevelt Bird Sanctuary, State Fish Hatchery, Jones Beach Bird Sanctuary, Massapequa and Belmont Parks, all of which will be visited.

Registration must be made in advance with Farida A. Wiley, American Museum of Natural History.

Camp Leadership Course

Farida A. Wiley, staff assistant in the department of education of the American Museum, has been asked to act as director of the Nature Lore Section of the Camp Leadership Course given by Teachers College.

The course aims to give demonstrations and suggested means of presenting a nature program in camps.

The sessions are held at Teachers College at 7:30 o'clock on Monday evenings, continuing through April 27.

Others giving assistance in the course are Mr. and Mrs. John R. Saunders and Mr. John Orth of the department of education, Miss Dorothy Bennett of the Planetarium staff, and Mrs. Ada K. Burns, director of the School Nature League.

Junior Astronomy Club

The season's activities of the Junior Astronomy Club draw to a close with the April meetings when James B. Rothschild, past president of the club, addresses the members on "Astronomy and Other Sciences" and the club advisor, Miss Dorothy Bennett, speaks on "Comets and Meteors."

Research in Dutch Guiana

Dr. Morton C. Kahn, associate professor of public health and preventive medicine, at Cornell University Medical College, returned recently from Dutch Guiana. Under the auspices of the American Museum and the former institution he has repeatedly visited Dutch Guiana for the primary purpose of continuing his intensive studies of tropical diseases, and secondarily to study the Bush Negroes and make ethnological collections for the Museum. On this, his latest expedition, he visited the Upper Aucaner Bush Negroes on the Tapanahoni River, making tuberculin tests and determining their blood groupings. The Museum already possesses a comprehensive collection from the Bush Negroes of Dutch Guiana. Doctor Kahn's latest contribution contains samples of unusually fine woodwork in the form of paddles, combs, and food stirrers from the Upper Aucaners and gives us a representation of artifacts from an additional Dutch Negro group not heretofore represented in the collections.

On the Upper Palumen River Doctor Kahn encountered a group of Alukuyana Indians who appear to have been almost entirely uninfluenced by any white contact. The Alukuyana trade, however, with the Aucaner, obtaining knives, machetes, etc., in exchange for hunting dogs which they breed and train. Doctor Kahn succeeded in securing for the Museum an Alukuyana bow and arrows and two jaguar bone flutes.

Fishes

Word has been received from Mr. William J. Morden, now in South America, that he is making contacts with a view to obtaining certain marine fishes desired by the department of ichthyology of the American Museum for study. Material is still being received from his last winter's stay in Honolulu and has made possible various conclusions now being published in *Novitates* and elsewhere.

Mr. Henry W. Fowler's first volume on the marine fishes of West Africa (605 pages; 275 text figures) has just appeared. The text figures were made by the author and show many strange and interesting forms. This work brings together the scattered literature on the fishes of that area and, when complete, will be invaluable to anyone working on collections from there.

Mr. Albert S. Pinkus, who has already deposited in the American Museum a collection of more than five thousand fishes from British Guiana, sailed again last month to do further collecting in that region. Mr. Boris A. Krukoff, whose large collection of Brazilian fishes is in the department of ichthyology, is still in the interior.

Exhibit of Classic Type Crystals

During the Annual Meetings of the Geological Society of America and the Mineralogical Society of America, the department of minerals and gems displayed in the Morgan Hall of the American Museum a series of type crystals, selected from the

Bement Collection because they have been figured in crystallographic papers by celebrated scientists of the nineteenth century. In many instances autograph and signed labels and original sketches accompanied these "Classic Type Crystals."

Penguins

Inadvertently, the penguins that formed the decorative motif for the cover of the March issue of *NATURAL HISTORY* were designated on the Contents page of that issue as "emperor" penguins. They are really "king" penguins, are next in size to the largest species of these flightless aquatic birds, and stand about three feet high. They occur at various antarctic and sub-antarctic islands.

George M. Wright
Roger W. Toll

The death, on February 25, 1936, of George M. Wright, chief of the Wildlife Division of the National Park Service since its establishment in 1933, and Major Roger W. Toll, superintendent of Yellowstone Park, who was another highly valued official of the Park Service, in an automobile accident near Deming, New Mexico, is a great shock to the many friends of both men and a misfortune to the National Park Service and to wild life conservation in general. They were on an official inspection tour at the time.

Mr. Wright was born in San Francisco, California, in 1904, and was a graduate of the College of Forestry of the University of California.

While studying forestry at the University of California, he accompanied Joseph S. Dixon, at that time Economic Mammalogist of the University, on an expedition to Mount McKinley, Alaska, where he discovered the nest of the surf bird. This nest, the first to be recorded, was found on a rocky ledge about one thousand feet above timber line.

After graduating, he served in the National Park Service as Ranger and Park Naturalist, but soon made himself such an authority on the wild life of the Parks that he was entrusted with developing the policies and directing the work for its conservation. His two reports on the Fauna of the National Parks, and the section on Recreation of the Report of the National Resources Board are outstanding contributions to conservation literature. Mr. Wright was a member of many forestry, scientific, and conservation organizations.

Major Toll was born in Denver, Colorado, in 1885, and received the degree of Civil Engineer from Columbia University in 1906. His career was a varied one, including service in the Army during the war. In 1919 he entered the National Park Service, of which he was one of the most able administrative officers.

Mr. Toll was a mountaineer of note, having climbed all the fifty mountain peaks in the Rocky Mountain Park and made, with three others, the first ascent of Mount Rainier by the Kautz Glacier Route.

Reviews of New Books

Astronomy, Birds, Conservation, Mammals, Distribution of Whales

STARS AND TELESCOPES. By James Stokley. (Harpers, 1936.)

ALTHOUGH the author of this book on astronomy is head of the Fels Planetarium at the Franklin Institute in Philadelphia and consequently a teacher of the subject, this is not a textbook, but a volume to be read, and it is interesting reading.

The treatment embraces the entire history of the science, and the gleanings of the important and the dramatic episodes has been done in a thoroughgoing manner. In fact we have here a combination of the story of the development of astronomy with an up-to-date and lucid discussion of the present status in all its various phases.

The author is peculiarly well fitted for the task he has undertaken. He has had for many years a special interest in the history of astronomy, and has collected in his private library many rare and valuable old volumes of interest in this his favorite field. Before the opening of the Fels Planetarium he was astronomical writer for Science Service,—thus keeping alive in himself the layman's point of view. This work together with his writing as special correspondent for the New York Times has kept him in close touch with the rapid development of astronomy. And finally, in directing the Philadelphia Planetarium since its opening, he has had abundant opportunity to learn what the general public wants to know, and he has profited by this experience.

While *Stars and Telescopes* is not a textbook, teachers of astronomy will find it a veritable *vade mecum* as a reference book, but to call it a reference book would be to give a very wrong impression. It is a most readable book telling the layman and the amateur astronomer what they want to know.—CLYDE FISHER

THE SOLAR SYSTEM AND ITS ORIGIN. By Henry Norris Russell. The Macmillan Co.

WITH that discipline of thought and brilliance of expression which distinguishes his performance with the pen or on the platform, the director of the Princeton University Observatory has discussed the problems of the solar system in a most thorough and readable book. He finds the system unusual in its isolation (it has no near star neighbors), in its complexity (there are more than 100,000 members of the family not counting the meteors), and in the distribution of its mass and movement.

A consideration of the earth's age, based largely on radio activity, yields a clue to its origin, for "about two billion years ago, or a bit more, something happened, and the earth was started on its present career. . . . Something happened, not only to the earth, but to the whole solar system." In fact, "It begins to look as if something had happened to the material universe at large. . . . The solar system is most evidently not a product of chance."

What, then, was the origin of this unique star family? Professor Russell dismisses the early ring theory of LaPlace with the words "It might form a swarm of asteroids, but not a single planet." What now? According to the author, "We are driven to the belief that the planets were separated from the sun . . . by the action of some external force." And yet, he states, "all forms of the encounter theory labor under grave difficulties," most of which hinge on the problem of angular momentum. While the sun claims 744 times the mass of all the planets put together, it supplies very little of the angular momentum of the system—the four major planets carrying the burden of it. To sort this with certain difficulties added by the satellites and the other members of the system, is the problem of a working theory.

Step by step, this leading astronomer, who is also research associate of the Mount Wilson Observatory, examines the leading theories of the origin of the sun's family in the light of recent research. Of the three sections of this short book (it is less than 150 pages in length) the first deals with the dynamical properties of the system, the last with its origin, and the second with its physical and chemical properties. The excellent new material on the planets and the sun in this second division, combined with the complete summary quality of the first, gives soundness to the final chapter which deals with theory. Piece by piece Doctor Russell takes these theories apart and finds all of them wanting. Even the dynamic encounter theory of Chamberlain and Moulton which had been quite satisfying, he is forced to regard with doubt in some of its aspects.

"But the solar system must have had an origin of some kind," says Doctor Russell, and then he proceeds to offer two suggestions. One is somewhat novel—but so is the solar system. It proposes the sun as a binary star with a small companion. At the close approach of or collision with a passing

star, the consequent breakup of the companion provided materials for the formation of the planets and other members of the system. Having advanced this idea, which is really a modification of the encounter theory, Doctor Russell shows its disadvantages and moves to his second startling thought that "at the start, all matter of the universe, perhaps, was tightly packed together in one great Atom. With this as a start, almost anything may have happened during the furious years and centuries in which the present universe began to take shape, and we need no longer worry about the details. . . . We conclude then, that no one can yet say how our system originated in detail, but may reasonably regard its birth as the merest incident in a far vaster process,—the shaping of the material universe as we know it."

With unusual completeness, clarity, and restraint, the dean of American astronomers has set a wealth of facts in order, and anyone who wishes to think intelligently on the subject will welcome his book.

—D. A. BENNETT

A PARADE OF ANCIENT ANIMALS. By Harold O. Whitnall. Thomas Y. Crowell Company, New York, 1936; 136 pages, 32 illustrations by H. C. Millard; \$2.00.

THIS is another addition to the already long list of books for children on prehistoric animal life. It is up to the average and will fill its purpose as well as any other available. The text is lucid and, on the whole, interesting, and the illustrations are clear and active.

At the same time it suffers from all the usual faults of such books. It does not show any of these in exaggerated degree, and in pointing them out, the purpose is not condemnation of this particular book. With so many works for children on natural history, and even on this very special branch of it, already on the market, it is certainly both fair and necessary to urge that a new book should eliminate these faults. This may be to demand a work of genius, but even if so, this is not an unreasonable demand after such a flood of works decidedly not of genius.

Simple scientific accuracy is surely the first essential, so what are we to say when we hear of *Eohippus* in the same scene as ground sloths, saber-tooth tigers, and other creatures no *Eohippus* ever saw? Or when we see a restoration of *Macrauchenia* labeled and discussed as being a camel? The restorations in general must also be noted as being purely imitative, without any evidence of real anatomical knowledge, and falling into most of the pitfalls set for imitators. The genius for whom we call would be able to interest children without introducing the big-bad-wolf and moral motifs into his narrative. This text bristles with such words as "bad," "lazy," "selfish," "horrible," "terrible," "monstrous," "cruellest," "blood-thirsty," "evil," "hideous," and the like, and it barely misses the Elsie-book moral that "good" animals survive and "bad" animals become extinct.

Our genius will also be simple in language with-

out being simple in thought, and he will not fall into discredited scientific clichés (like supposed extinction of dinosaurs by egg-eating mammals) just because they are simple.

But until such a work of genius appears, Professor Whitnall's book will serve very well on the whole.—G. G. S.

THE BOOK OF THE SEASHORE. *The Life Experiences of a Naturalist on the Beach.* By Howard J. Shannon. Illustrated by the Author. Doubleday, Doran and Company, Inc., Garden City, N. Y. 1935. \$3.50.

WITH the turn of the year toward spring, there is a familiar Spirit that begins to beckon above the horizon to all those city dwellers and others, too, housebound, who love the Sea,—to all those who feel that they can draw their deepest and most life-giving breaths only where the tangy breezes of Old Ocean race and whip and tear, and like fighting gladiators, come to grips with the waves as they strike upon the shore.

Engulfing the sands in their foam and surging out again, only to renew their resistless attacks, the waters suck back with them everything that seeks a foothold in the moving, grinding, slipping whirligig of sandgrains—seaweed, vegetation, shell-fish, insects, birds, mice—and sometimes even man.

There is life, and living everywhere; not a dull moment, not a moment to spare in the feverish struggle to win and hold a place in the race for survival.

But there is beauty, too, of color, form, and sound, and surging through it all, there are infinite courage, patience, skill, cunning, pitiless might and pitiful helplessness, evident to the eye and mind keen to note such things. Such keenness is possessed by Howard J. Shannon. He proves this by his story of the life experiences of a naturalist on the beach, in *The Book of the Seashore*.

For twenty-six years he has studied the pageant of Nature along the Atlantic Coast from above Wood's Hole south to the tip of the New Jersey peninsula, and particularly along the south shore of Long Island. What he learned became a part of himself, and now he sends it forth to whomsoever would learn also. As revealed through his eyes and sympathetic understanding the life along the seashore lives again in all its profound simplicity and complexity, its beauty and ugliness, its joy of living and terror of annihilation.

No more authoritative tribute to the value and dramatic interest of Howard Shannon's contribution to man's knowledge of the life of the seashore could be written than the Foreword to the volume, by Dr. Roy W. Miner, curator of living invertebrates, at the American Museum. Doctor Miner writes:

There are poets. There are artists. There are naturalists. But it is not often that the attributes of all three are combined in one person.

Howard J. Shannon is an artist. Many years ago, he walked upon a Long Island beach. Its wild beauty tempted his brush. He began to transfer it to Bristol board. The long vista of snowy shore, the shifting dunes, the rolling of the surf, the drowsy, summer days of mellow sunshine, alternating with the grandeur of the stormcloud and

menace of the tempest-tossed sea—all these inspired his soul, so that eloquent word pictures covered the pages of his notebooks. He became a poet.

His keen powers of observation opened his mind to the surging plant and animal life about him. He noted the desperate struggle waged by the hardy beach vegetation against the far-flung and aggressive battle line of the mordant sea waves, and the scars both tree and shrub bore of the conflict. He saw the valiant endeavor of the beach insects to build their homes in the uncertain soil; the foraging sea birds snatching their food from the turmoil of boiling surf; and witnessed the ingenious methods by means of which the animals beneath the ocean's margin wrought their tumultuous environment into protective structures for their own use. Howard Shannon became a naturalist.

Thenceforth he lived upon the beach. His observations extended through the seasons, through the years! The phenomena of the mysterious migrating journeys of insect, bird, and fish absorbed his attention; the physical changes of the shoreline from year to year engrossed his mind with the past history of the beach. He spanned the centuries. Not content, he unearthed fossil remains of strands of bygone geological ages, which opened to his investigating, poetic mind vistas of pre-glacial days; and before that, the old, Cretaceous beach with its lush tropical jungles that existed in that very region a hundred million years ago.

Howard Shannon lived the life of his beach for more than a quarter of a century, and, in this book, with brush and pen, he has pictured it for his readers by means of an abundance of luminous illustrations; and, even more vividly, by imaginative and poetic word pictures, which because they have caught both the visible and invisible spirit of his world by the sea, present the vital throbbings of its heartbeats and the embattled struggles of its inhabitants far more accurately than any cold statement of listed facts.

Many of Mr. Shannon's observations are original and distinct contributions to science. He has discovered new species and new facts of life history; while his investigations of seasonal insect migration, as presented in previous publications, have attracted the interested comment of careful students of that subject.

I am sure that Mr. Shannon's readers will find the perusal of this volume a delightful experience, whether they are seated comfortably in an armchair by a winter fireside, or lazily stretched out of a summer's day on the sands by the resounding sea, bathed in the atmosphere which permeates both book and physical environment to blend in a mutually illuminating whole.

It was such an observer that Bryant must have had in mind when he wrote in "Thanatopsis" the never-too-often-quoted words:

"To him, who, in the love of nature
Holds communion with her visible forms
She speaks a various language."

—A. KATHERINE BERGER

THE LONDON CONVENTION FOR THE PROTECTION OF AFRICAN FAUNA AND FLORA. *Special Publication of the American Committee for International Wild Life Protection, No. 6, Cambridge, Mass., 1935.*

THE London Convention for the Protection of African Fauna and Flora met in the House of Lords in October, 1933. It attracted considerable attention at the time of the meeting, and when a full report of the proceedings reached the American Museum of Natural History, the Scientific Staff passed a resolution, at a meeting held on March 13, 1934, commending the high purposes and achievements of the Convention.

The American Committee for International Wild Life Protection, John C. Phillips, chairman, in a special publication, No. 6, 1935, has recorded in permanent fashion the story of the London Convention of 1933. This special publication is an attractive brochure of large format containing a large folding map of Africa. In a foreword, the background for the meeting is given and it is stated that the Convention of 1933 "was in reality a revival of the London Convention of 1900 on the same subject, which unfortunately was never ratified. More recently, a resolution calling for another

Convention was passed at the International Congress for the Protection of Nature which was held in Paris in 1931."

"Of the many accomplishments of the Convention, none are more important than those which define and recommend the four types of parks and reserves. Perhaps the second most important accomplishment is the agreement found in Article 9, which aims to control the commercial exploitation of animal products.

"The so-called Protocol is extremely important as it provides for the holding of periodical International Conferences in the future and also refers back to Article 1, wherein provision is made for the extension of the treaty to countries which do not hold territory in Africa."

The plenipotentiaries who attended the Convention represented "The Governments of the Union of South Africa, Belgium, the United Kingdom of Great Britain and Northern Ireland, Egypt, Spain, France, Italy, Portugal, and the Anglo-Egyptian Sudan."

"Considering that the natural fauna and flora of certain parts of the world, and in particular of Africa, are in danger, in present conditions, of extinction or permanent injury:

"Desiring to institute a special régime for the preservation of fauna and flora;

"Considering that such preservation can best be achieved (i) by the constitution of national parks, strict natural reserves, and other reserves within which the hunting, killing, or capturing of fauna, and the collection or destruction of flora shall be limited or prohibited, (ii) by the institution of regulations concerning the hunting, killing, and capturing of fauna outside such areas, (iii) by the regulation of the traffic in trophies, and (iv) by the prohibition of certain methods of, and weapons for the, hunting, killing, and capturing of fauna;,"

After printing in full the series of 19 Articles upon which the Convention agreed, the report of the American Committee includes the Annex authorized under Article 8, to which it has added, however, illustrations of the various species concerned. The protection of the species mentioned in the Annex was declared to be especially important. The Annex groups animals (and plants) into Class A, those to be protected as completely as possible, gorilla, giant sable, okapi, whale-headed stork, et cetera, and Class B, species not to be hunted except under special license, colobus monkey, chimpanzee, giraffe, white-tailed gnu, ostrich, secretary bird, et cetera. A list of the African game reserves and parks concludes the report.

The London Convention through the joint efforts of the plenipotentiaries working in harmony has made a very auspicious attack upon a problem of great interest to nature lovers and conservationists throughout the world. While it cannot be denied that in many sections of Africa exploitation of wild life has already gone so far that irreparable damage has been done, nevertheless it is encouraging that there is a recognition of this very fact and that the powers concerned are aroused and desire to enact protective measures.—H. E. ANTHONY

NOTES ON THE SOUTH AFRICAN WILD LIFE CONSERVATION PARKS AND RESERVES. By *Thomas Barbour and Margaret D. Porter*. Publication No. 7. *The American Committee*.

THE American Committee has followed up the report of the London Convention with a special publication, No. 7, entitled "Notes on South African Wild Life Conservation Parks and Reserves," by Thomas Barbour and Margaret D. Porter.

This publication reports on a brief visit to South Africa, including about a week in the Kruger National Park. A map shows the location of some sixteen South African Parks and Reserves which may be classified under three headings typified (1) by the Kruger National Park "which perpetuates over a large area a sample of the sort of conditions which once obtained over a large part of South Africa," (2) by the Drakensberg National Park "which was originally established to preserve and make accessible magnificent national scenery," and (3) by the Bontebok Park which represents "what might be called last resort efforts to preserve a particular species on the very verge of extinction."

Some of the points brought out in this report demonstrate the need for prompt action such as that initiated at the London Convention. Comments on the ease of obtaining a license to kill everything, except a few species known as royal game, indicate that it is high time more stringent restrictions are placed upon the privilege of hunting. The securing of land to fill out existing boundaries will be easier now than at some future time. "The golden opportunity exists right now."

The mountain zebra is catalogued as a vanishing species, the numbers of which are stated as "probably not over a hundred." "Three animals of the High Veldt are among the most extraordinary and interesting of all African antelopes. Their status varies somewhat." "The white-tailed gnu, commonly called the black wildebeest, suffered frightfully from the drought of the last few years and unless something is done to establish a special Park for this animal, with adequate artificial water supply, its outlook is very gloomy." "The case of the blesbok is not as unfavorable as that of the black wildebeest. However, with the exception of some six hundred animals in the Sommersville Reserve of the Orange Free State, all blesbok are in private hands." "The third animal in this category is the springbok—an animal of extraordinary beauty and grace—once the most abundant of all South African animals—now pitifully reduced in numbers."

The reader of this report will find his sentiments swayed between gratification that so many reserves have been created in South Africa and regret that the destructive forces of recent years have taken such a heavy toll of the primitive wild life.

—H. E. ANTHONY

As a timely commentary on the topics covered by the two foregoing special publications of the American Committee, a newspaper article appears in the *Natal Mercury*, January 1, 1936, under the name of Dr. E. L. Gill, director of the South

African Museum. This newspaper account bears the headlines, "Doom of the Precious Cape Mountain Zebra—Dying Species Which the State Has Declined to Reprieve."

Doctor Gill writes, "Another blow has fallen—quite possibly the final blow—on the ill-fated mountain zebra."

"If this is not its obituary notice that we are writing it is something desperately near it. Little short of a miracle is needed now to save it. That has, in fact, been the position for a year or two, except that till now there has been some hope that the miracle would be given a chance to happen. That hope has now been dashed by a pronouncement from the Minister of Lands."

"The mountain zebra has had a strange history. Until half a century ago it was a common inhabitant of the mountain ranges of the Cape. It was the first kind of zebra to become known to European naturalists, and as such it is the sole possessor of the name zebra in scientific nomenclature."

"... In 1922 there were 400. Now there are between 40 and 50, about half of them in the Cradock district and the other half near Oudtshoorn."

"Fifty or sixty is a perilously small number to count upon for saving the species from extinction, especially since there is no hope of bringing the two herds together and little prospect that both can be maintained much longer. ... There is only one hope of saving either of them permanently, and that is to turn their natural range into a reserve."

"For two years now the wild life protection organizations of Europe and America have been anxiously watching to see what we are going to do about the mountain zebra. Our Government provided for the bontebok, but in the much more urgent case of the mountain zebra all our efforts seemed to have failed to arouse the slightest interest."

"At length, in the last six months, we began to think our appeals were being heard. We hoped it was a question, not of setting up a reserve at all, but as to whether the reserve was to be at Oudtshoorn or Cradock. Now the Minister of Lands announces that enough has been spent for the present on wild life protection and that it will not be possible to do anything 'next year' for the mountain zebra. Not even next year!"

In the same newspaper, an editorial, "Wasting Nature's Heritage," comments favorably upon Doctor Gill's appeal and utters the following sentiments which have a familiar sound to conservationists the world around, as the conditions decried by the editorial are not peculiar to South Africa.

"This sounds to us very much like apathy of the most shortsighted kind. Providence endowed South Africa with the most wonderful and varied wild life in the world. For the past century we have been busy, with every means at our disposal, exterminating this fauna as rapidly as possible. Indeed, but for the public-spirited action of a handful of individuals who were sufficiently farseeing to realize what a precious heritage was thus being thoughtlessly dissipated, there would have been practically no wild life at all left today."

"Fortunately the National Parks Trust was created in the nick of time and steps were taken to throw the Kruger Reserve open to the public. Efforts to preserve game were made in other directions. But there is still much to be done, as witness Doctor Gill's warning concerning the precious mountain zebra and the still unsettled problem of the Zululand game reserves."

Conservationists in the United States should scarcely presume, in view of what has happened in their own country, to go very far in telling peoples of other lands how to handle their wild life problems, but at least they may be privileged to hope that some constructive measures to save the mountain zebra will be taken before it is too late.

—H. E. ANTHONY

THE DISTRIBUTION OF CERTAIN WHALES AS SHOWN BY LOGBOOK RECORDS OF AMERICAN WHALESHIPS. By Charles H. Townsend, *Zoologica*, Vol. 19, No. 1, Apr. 3, 1935, New York Zoological Society.

DOCTOR TOWNSEND has compiled a most interesting series of records and made available to naturalists a great accumulation of observations which have, in the past, been buried in the logbooks of the old-time whalers.

In his introduction he writes, "While examining logbooks of old-time whaling vessels in the New Bedford Public Library a few years ago, it became apparent to the writer that they represented a supply of hitherto unused records available for much additional information on the distribution of whales. The logbooks, hundreds in number, show clearly where the nineteenth century whaler made his catches of sperm, bowhead, right, and humpback whales. It appeared that by plating on charts the positions where large numbers of whales had been taken, much could be learned of their distribution and something of their migrations."

The author proceeds to analyze the platted data, and a glance at the maps makes it very apparent that these platings afford a very good insight into the distributions and moves of certain whales. The movements of whales are to be correlated with feeding habits, and a map of the ocean currents is

given in order to afford the student a background for attempting to correlate the positions of the whaling grounds with ocean currents. This relationship has been discussed at considerable length by Wilkes (1845) and Maury (1855) and Doctor Townsend states that he "after much study of recent oceanographic literature, abandons his attempt to set forth what is known of their relationship."

The charts are large, folded documents, and Charts A and B give the distribution of the sperm whale based on logbook records dating from 1761 to 1920. On these two charts are platted a total catch of 36,908 sperm whales. Chart A records the take from April to September, inclusive, and Chart B from October to March, inclusive.

Chart C shows the distribution of northern and southern right whales based on logbook records dating from 1785 to 1913, and the positions represent catches of 8,415 right whales.

Chart D gives the distribution of bowhead and humpback whales based on logbook records of mostly nineteenth century and represents catches of 5114 bowhead and 2883 humpback whales.

These charts must be studied to be appreciated. The plating of these thousands of records has called for infinite patience. Doctor Townsend, with his knowledge of the Seven Seas based upon personal observations over a number of years, has had an able collaborator in Mr. A. C. Watson. Furthermore, this report could not have attained such a high degree of excellence had not the owners of the logbooks cooperated in making the data available. Doctor Townsend concludes his paper with a list of the sources from which data has been drawn, and with a table giving the names of the vessels, the dates of the voyages, and the number of whales taken.—H. E. ANTHONY

Recent Museum Publications

Oceanic Birds of South America. Volumes I, II.
By Robert Cushman Murphy.

BULLETIN

Vol. LXX, Part 1.—The Marine Fishes of West Africa. Based on the Collection of The American Museum Congo Expedition, 1909-1915. By Henry W. Fowler.

RECENTLY ELECTED MEMBERS

A REPORT from the membership department lists the following persons who have been elected members of the American Museum:

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Misses Dorothy M. Anderson, Ann Baron, Herdis Bentson, Dorothy Brodie, Pauline L. Burgess, Agnes B. Corell, Isabel G. Donnelly, Jane Forsyth, Ruth A. Handy, Fannie Juster, Idella A. Kennedy, Ora Kingsley, Anna B. Kirk, Lillian M. Lawson, Fannie Elthera Melhuish, Rachael H. Michael, Mildred E. Nelson, Eliza D. Olsen, Dorothy Petrie, Shirley D. Putnam, Sylvia M. Putnam, Joan Vicary Rigg, Irene B. Robinson, Laura Slocum, F. Blanche Smith, Nell B. Stockwell, Mary E. Stutzenburg, Lois E. Te Winkel, Margaret Thompson, Ruth Marie Timm, Alice Tingley, S. Edith Townsend, Amy M. Vaughn, Grace Lois Webster, Susan E. Wheat, Rita Wilkinson, Laetilia E. Williams, Sybil Woodruff.

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The Journal of the American Museum of Natural History

VOLUME XXXVII

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The water can be seen plainly in the natural "bottle"

★

THE INDOOR EXPLORER

★

By GORDON LAWRENCE

IT SEEMS that it did not take the Indians of the eastern seaboard very long to realize the advantages of clothes cut in an approximation of the European manner. Until the country was settled by the whites the Indians wore a sort of poncho or night shirt made of two skins for an upper garment, and hip-length leggings in lieu of breeches.

But the costume of our eastern Indians changed quickly after white settlement, according to Dr. Clark Wissler. To illustrate this, the department of anthropology recently installed a costumed life-sized figure of an Indian of the New York region during the period of the American Revolution. This brave is carrying a gun almost as tall as himself, a knife, and a tomahawk, all bought from white traders, and wears a sash of beads and bead ornaments procured from the same source. His black hair is done up in two braids tied up with red cloth.

The rest of the Indian's costume, moccasins, fur cap, rawhide coat, skin breech cloth, and leggings, and the shell ornament on his neck, as well as his powder horn, are obviously of home manufacture, but the design of the coat

is, of course, to some extent imitative of European clothing, and the cap has a cloth sweat band.

To the layman, it seems curious that while the Indian was taking over the coat, he did not also adopt what seems to be the most practical garment ever devised, that is, trousers. As Doctor Wissler points out, "Even today Indians on some reservations wear long cloth leggings instead of trousers."

Natural water bottles

THE SKEPTICAL youth who had been staring at the semi-precious gems was polite but reserved when Curator Whitlock assured him that opals did have water inside them, even if you couldn't see it or feel it. The boy complained that the glassy surface of the opal didn't seem in the least wet to him.

But his air of world weariness lightened when Mr. Whitlock drew forth some of his natural water bottles. The Museum has a lot of them and the water in them is assumed to be potable. You pick up a large blob of dull white quartz—shake it, and you hear an in-

ternal gurgling like that of the milk within a ripe coconut. Some of these naturally sealed containers are semi-transparent and when they are held up to the light the water inside looms up like the horizon through a January fog.

None of the water bottles in the Museum has yet developed a leak, according to Mr. Whitlock. They are to be discovered wherever geodes are found—which is wherever silica-impregnated water has filtered down through certain rocks, basalt, for example. The water drips down into any cavities in the rock, and if these are at a considerable depth, and consequently under heavy pressure, the mineral matter in suspension in the water eventually crystallizes around the sides of the cavity, to form a more or less rounded container for the pure water left inside. When the bottles are sawn in two, the quartz crystals are seen lining the interior like the amethyst crystals of a grotto. As a matter of fact, as Mr. Whitlock points out, these water bottles are grottos in miniature.

The farthest south in fish

THE MUSEUM has received what is presumably the most southerly specimen of a fish ever collected, and considering that this inch and a half long individual was found by Mr. James M. Sterrett of the Second Byrd Antarctic Expedition in a seal hole in the ice at Echo Canyon, some sixteen miles southwest of Little America, it is not likely that living fish can ever be found much farther south.

The fish, which looks pale and homely enough reposing in alcohol, has been named *Pagothenia antarctica* by Mr. J. T. Nichols and Miss F. R. LaMonte. In life it apparently spent most of its time close to "narrow crevices or pockets in the wall of the crevasse" into which it retreated when disturbed.

Pagothenia was taken in approximately lat. 78° 45' S. From a very short distance farther north the Museum received a series of a somewhat larger fish, *Pleuragramma antarcticum*, which, according to Mr. Paul Siple, of the Byrd Expedition staff, is apparently the major food of the Weddell seal. One seal was found to have about 400 of these fish in its stomach.

As Mr. Nichols points out, "This *Pleuragramma* held the record as the most southerly fish ever captured by man prior to the last Byrd expedition—and it was known only from

a few fragmentary specimens. From the abundance of sea birds and the numbers of seals in the Antarctic it is evident that the fish life of these waters must be a rich one."

Fossil hunting at home

WHEN AFRICAN HALL and the Roosevelt Memorial were erected, the Museum received a large accession of fossil specimens without sending out any expeditions to procure them. These fossils, one might say, were thrown in with the buildings. The smooth and creamy Pandora marble that panels the upper hallways and stairways of the Roosevelt Memorial entombs what remains of many an ancient creature that once fringed old sea beaches.

The numerous irregular figures that show so plainly in the polished surface of this rock are cross-sections of calcareous algæ (*Lithothamnium*) most closely related to the lime secreting algæ of the mid-Tertiary periods, according to Dr. Chester A. Reeds, Curator of Geology and Invertebrate Palæontology. More striking are the occasional elongated shells, with a structure that vaguely resembles a corkscrew to the uninitiated. These were identified by Doctor Reeds as univalves (Gastropoda), a group that was very abundant during the Mesozoic and Cenozoic eras and are still found in large numbers along our present-day seashores.

The beautiful slabs of the mottled reddish Spanish marble, the so-called Catalan Red, which serve as base-boards in the Roosevelt Memorial Building, reveal, on close search, the wheel-shaped outlines of fossils which represent cross-sections of cup corals with radiating septa. Some millions of years ago these coral animals were leading the same uneventful life in placid marine waters that their cousins do today.

A still richer field of fossils is found in the Napoleon Grey marble in the lavatories in African Hall. This stone is brownish-grey in color, and its glassy-smooth surface shows a subcrystalline close-grained rock representing vanished beaches almost as plainly as when the waters of ancient seas lapped over them. The history of the beach can be read plainly in the alternating deposits; some bands show grains so small that they can hardly be seen.

Scattered through these bands are a vast

number of single curved valves of the brachiopods *Spirifer logani*, *Spirifer orbicularis* and *Syringotheras subcuspidatus*, which made an easy living by placidly straining out the tiny animals and plants abundant in the shallow seas of middle Mississippian time. Then there are a large number of round objects, that look something like ancient coins, which represent transverse sections of crinoid stems and cup corals, according to Dr. Reeds. The most striking of the oblong and slightly curved shells with radiating partitions that divide the shell into chambers represent longitudinal and tangential sections of the cup coral *Zaphrentis centralis*.

The Department of Geology has on display rocks in which fossils are much more thickly crowded than in these. A good example is the *Nerinea* limestone, from Syria, the polished surface of which is so packed with the carrot-shaped shells of *Nerinea fleurbaeui* that the chalky limestone seems merely a matrix for the long brown shells.

On the distribution of Birds

IT LOOKS as if the 1200 copies of Dr. Robert Cushman Murphy's monumental *Oceanic Birds of South America* were going to be pretty well distributed over the known world.

President Franklin D. Roosevelt, who bought two copies, was one of the first subscribers. Other early purchasers were Prince Taka-Tsukasa, the Marquis Hachisuka, and the Marquis Yoshemaro Yamashina, all of Tokio, Sir Charles F. Belcher, governor of Trinidad, and the head of the Tribal Council of the Navajo Nation, Thomas E. Dodge by name, who maintains his headquarters at Fort Defiance, Arizona, over 400 miles from the nearest salt water and presumably that far from the probable line of flight of any salt water birds.

Among the very first and most appropriate subscriptions for a treatise on South American sea birds was that of the Peruvian Guano Administration. Orders for five sets have already been received from Peru and eight from Russia, including subscriptions from the Siberian Section of the Russian Geographical Society in Irkutsk (which is three times as far from salt water as Fort Defiance is).

The farthest north for *Oceanic Birds* so far

is the Landsbokasfnid of Reyjavik, Iceland, which is likely to retain this distinction unless some polar explorer takes along a set to while away the long Arctic night. So far no copies have been ordered for Antarctica, but among the famous institutions and people already purchasing the book are the Musee Oceanographique at Monaco, where Doctor Murphy once worked (and, of course, many of the more important museums and universities of the world), Boris A. Bakmeteff, last Imperial Russian ambassador to this country; John Bassett Moore; George Blumenthal, president of the Metropolitan Museum of Art; Mrs. W. L. Harkness, Duncan H. Read, Frank W. Benson, the etcher of shore birds and ducks; Childs Frick, Daniel E. Pomeroy, Leonard C. Sanford, Lord William Percy, George W. Perkins, Herbert L. Satterlee, Mrs. Harry Payne Whitney, who bought five sets; former Senator Walcott of Connecticut, John Hays Hammond, Jr., and the former King Ferdinand of Bulgaria.

Back in the dim days when Dom Pedro ruled in Brazil it seems that Ferdinand collected many a bird in that country. Later, when reigning in Bulgaria, he maintained a court ornithologist. His son and successor, the studious Boris, is also a naturalist by avocation.

A letter from Stefansson

THIS MONTH NATURAL HISTORY publishes one of the first articles to appear in the United States on an important subject that is very little known, the exploration and the beginnings of the development of the Arctic by Soviet Russia.

There are no political inferences to be drawn from this article, of course, but there is abundant reason why Russia, of all nations, should be profoundly interested in the development of the Arctic. In the first place, something like four-ninths of the great circle of northernmost lands and waters is possessed by Russia, a much larger share than that of any other nation. And then there is that problem that has always bedeviled the rulers of Russia, whether Tsars or Communists—the fact that she alone, among the great nations, is practically ice-bound so far as ocean transport is concerned every winter, with only that one northerly ice-free port of Murmansk.

The editors of NATURAL HISTORY have received the following letter from the distinguished explorer, Vilhjalmur Stefansson, which serves as an interesting introduction to Mr. Shipman's article:

"NATURAL HISTORY is to be congratulated on the news which I get from you that you are intending to publish a contribution on exploration and pioneering in the Soviet Arctic. For several years I have been following these activities as best I could, hampered by inability to read the original Russian in which many of the reports have been published. However, various serial publications of the Arctic Institute have been increasingly considerate of western scholars in printing summaries in English, French, or German. Indeed, a good many of the contributions, some of them of major importance, have been published in a western language. There are, too, western publications which follow and summarize the activity of Soviet explorers. Notable in this field, and increasingly complete, is the semi-annual *Polar Record*, published by the Scott Polar Research Institute of Cambridge, England.

"The summaries of the *Polar Record* demonstrate that for some years the explorers of the Soviet Union have been doing more in the Arctic than was being done in Arctic and Antarctic combined by the explorers of all the other nations of the world. By 1935 they had far outdistanced the combined achievements of the rest of the world.

"The broad credit for northern scientific research and development goes, of course, to the general policy of the Soviet Government. Thereafter comes the leadership of Professor Otto Schmidt, whose office as director of northern development approaches what we would think of in the United States as cabinet rank. No nation in recent times, if any nation ever, has given such importance to geographic exploration.

"The author whom you have chosen to present the subject. Mr. S. S. Shipman, is peculiarly well placed for securing complete and authentic information.

"Again congratulations, then, to NATURAL HISTORY for taking up in semi-popular form, through Mr. Shipman's contribution, the enlightenment of English-language readers with regard to those northern activities of the U.S.S.R. which, in comparison with our own, are so colossal; and which hitherto have been little noticed except by technical students and those few others who consult the *Polar Record*."—VILHJALMUR STEFANSSON.

Is Redfern alive?

NINE YEARS ago the young aviator, Paul Redfern, attempting a non-stop flight from Brunswick, Ga., to Rio de Janeiro, crashed down into the unmapped forest of Guiana. Since that summer of 1927 there have been strange stories, and even individuals who claimed to have met Redfern face to face in

some unheard-of Indian village. But even the traveler who claimed that Redfern had taken himself an Indian wife was unable to substantiate his story.

When Doctor Kahn (whose article appears in this issue of NATURAL HISTORY) showed the moving pictures of his expedition at the Explorers' Club a lean and energetic listener displayed so much interest that Doctor Kahn took the pictures to the listener's office for a private showing. The interested gentleman was Captain Lewis A. Yancey, who himself flew in 1930 over the country where Redfern probably cracked up.

The finding of a white man

As Doctor Kahn reeled off the sequence of the Indian gesticulating to convey his story of the finding of a white man, Captain Yancey stared eagerly at the Alukuyana's pantomime.

"It can't represent anything but the intentional crack-up of a plane," he decided.

It seems that when your plane stalls twenty or thirty feet in the air the bounce you make on landing is likely to be a disastrous one. Captain Yancey himself has had the experience of deliberately smashing a wing, once, for example, when his plane dropped a valve near Nassau in the Bahamas. With no place to land except a small rocky beach, there was no room to do any bouncing. Yancey made a stalled landing, smashing the plane pretty thoroughly, but neither he, the radio operator nor the mechanic received a scratch.

Supposing that Redfern is indeed still alive, one wonders what one's own reactions would be if one were to drop out of a tropic sky down into a green wilderness among a people of a culture ages behind our own—and live there nine years, farther removed from our modern civilization than Mark Twain's Connecticut Yankee was when he cursed the suit of armor they gave him at King Arthur's court.

Two expeditions are now searching for Redfern. If they or anyone else ever find him alive there will be a great story to tell—of nine years or more of existence in the very backwaters of the world while expedition after expedition tried to pick up his trail, and now and then vague rumors came to the world he had left that somewhere in the silent forests of Guiana a fallen flyer was held captive.



BUSH NEGRO BEATING SIGNAL DRUM

The Bush Negroes, the descendants of rebel slaves, survive in a section of northern South America. Two centuries and more ago their ancestors revolted against the Dutch, fled into the jungle,

and after a series of long and bloody wars, established their independence. Their culture shows many striking West African survivals. The apinti or signal drum is used also for dances

Where Black Man Meets Red

Adventures in medical research among two strange tribes of Dutch Guiana. Notes on the possible whereabouts of the aviator Redfern

By MORTON C. KAHN

*Department of Public Health and Preventive Medicine,
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THE scientific explorer besides having to travel a certain distance into difficult country, usually faces the problem of securing the friendship of the natives among whom he is to work. This latter procedure, though rarely described in detail, involves some of the most interesting experiences.

My recent expedition to the back country of Dutch Guiana was unique in that it brought me into contact with primitive people of two distinctly different races, the black and the red. The Bush Negroes are that interesting group of blacks who, although they were transported to this hemisphere originally as slaves, won their freedom in armed conflict with the white man and maintain it to the present time. In a foreign setting they have retained to a remarkable degree the culture of their West African forebears. The Alukuyana Indians, of the red race, are the tribe who inhabit the country directly back of the Upper Aucaner Bush Negroes in the little known interior of Dutch Guiana. Many of them have never seen a white person.

One of my purposes was to make tuberculin tests on people of both these groups and to collect samples of their blood for purposes of grouping.

Upstream in 'dug-outs

With my two able assistants, namely Mr. Ralph F. Donaldson in charge of cinematography, and Mr. E. W. Rogalli of the Dutch Guiana Government Service, I proceeded by sea from Paramaribo the port of Dutch Guiana, to Albina just above the mouth of the

Marowyne (Maroni) river, a distance of over a hundred miles. The Marowyne marks the boundary between French and Dutch Guiana, and from Albina one may see the town of St. Laurent which is the main prison port of French Guiana and the centre of the penitentiary system popularly known as the Devil's Island Penal Colony. Here we reloaded our baggage into five 40-foot dug-out canoes, and with the help of twenty-two husky Bush Negro paddlers proceeded on our way.

Today there are six tribes of Bush Negroes all descended from the rebel slaves of 190 and more years ago. On the Copenam River, there is a tribe known as the Quintee; those Bush Negroes who inhabit the upper Saramacca River call themselves the Matawaai; while the large tribe on the Surinam are interestingly enough called the Saramaccaner. Then there are the Boni on the French Guiana side of the Marowyne and Lawa rivers, and a small group, the Paramaccas, who inhabit the shores and islands of the middle Marowyne.

Once fugitives

But to my mind the most interesting of all the Bush Negro tribes are the Aucaners, descended from rebel slaves, who signed a treaty of peace with the Dutch in 1761 at the Ouca plantation. There are about 6000 of these people scattered in a less compact way on the rivers and creeks of the colony toward the French Guiana line. The tribe is divided into two parts known as the "Uppo Nengre" (upper Negroes) and "Belo Nengre" (lower Negroes). All members of the tribe living below the Gran Holo (Big Hole) Falls in the Tapanahoni River belong to the Belo or lower

Aucaner group, while the real aristocrats of the tribe live above this dividing line.

In the villages of the Upper Aucaners are found the clans or "lo" from which the King or "Granman" of the entire tribe is selected. These are the Otter lo and the Missi Jon. The Upper Aucaners live in the wildest and most inaccessible part of Dutch Guiana, and have had the least contact of any Bush Negro tribes with the white men.

After seven days of arduous paddling and poling over innumerable falls and rapids, we reached the end of the Marowynne River and entered the mouth of the Tapanahoni. The seat of the Chief or "Granman" of the Aucaner tribe is the village of Dree Tabiki (The Three Islands), but before one may enter this precinct it is necessary to inform the Granman and Council of one's proposed arrival and to await the necessary permission. This was accomplished by dispatching a small canoe two days ahead of my main party.

Overtures

The messengers returned and informed me that desired permission had been granted, but that my party was to wait at a certain point just out of sight of Dree Tabiki and to fire a gun three times as a signal. We were not to proceed until three gun shots were heard in answer from the village which would signify that Kanapé, the head Captain of the Aucaner tribe was ready to receive me.

Kanapé is not the Granman of the tribe. Since the death of old Amekti, some four years ago, however, Kanapé has been the official ruler. A young Bush Negro by the name of Matoja, is the rightful heir to the title but the Bush Negroes consider him too young and inexperienced for such a position, and will not inaugurate him until he is considerably older. When I saw him this winter, he appeared to be about twenty-five years of age.

After a wait of about two hours, I heard the gunshot signal from the village and motioned my canoes to fall in line one behind the other, which is the accepted etiquette of approach. As we paddled slowly to the shore most of the villagers were assembled there in colorful array to greet us, including the most powerful Captains of the tribe, who had been summoned by Kanapé for the ensuing *Krutu* or Council. As we approached the landing

place the Bush Negroes fired several salutes from their old muzzle loaders and percussion cap shot guns while we answered with all available fire arms—rifles, shot guns and revolvers. After several such salutary exchanges my canoe finally touched the shore from which I was assisted in a most dignified way by the Reception Committee, composed of Captains Gagoo, Abompé, Sekendo, Sava, Tonka, Mosi, Batu and Dabooto.

It was not until I had gone some distance up the trail leading to the village, however, and had passed under the Azang Pau, the phantom barrier of palm fronds, under which all must pass to cleanse them from any evil intentions, that I was finally greeted by Kanapé. This handsome specimen of dignified manhood was resplendent in his ceremonial regalia, which included a silk top hat, a drum major's baton and a silver plaque hanging from his neck, upon which was embossed the arms of Dutch Guiana, the official badge of his office, given him by the Government. Some of these insignia still in possession of the tribesmen date from shortly after the signing of the peace in 1761.

Primitive formality

The greeting, which never varies, is somewhat as follows:

"*Odio Bahkra fy you deh, b'a*" (Howdy, white man. How are you, brother?)

"*Havu so, Granman, fy you deh, B'a*" (So, so, Granman—How are you, brother?)

To which he replies: "*Havu so.*" (It does not do to claim that one is feeling too well, otherwise the enmity of the spirits might be incurred.)

"*We meetee baka*" (We meet again).

"*E-yah we meetee baka*" (Yes we meet again).

I then proceeded as follows: "*Granman—Dissee wan muy condree*" (This is a fine village).

"*Ala you suma deh muy tumussi*" (All of your people are very nice indeed).

To which he replied: "*E-yah Bahkra datti Bon*" (Yes, white man, that is good).

He then motioned me to follow him to the *Krutu Oso* or Council House and we were soon comfortably seated on the carved ceremonial benches surrounded by the Captains and other dignitaries of the tribe while the

outside walls of the large hut were almost completely surrounded by villagers. I then proceeded somewhat as follows:

"Granman I have come a long way to your country, many days and nights on the white man's big boat I have travelled—many days of travel on your rivers. I do not come for gold, I do not come for lumber, I do not come for the sap of the wild rubber tree, nor yet do I come to tell you stories of religion or to try to change the God of your people. I come only to make an inspection of your people for a certain illness and to help them in any way I can. I would also like to take a few photographs and collect the beautiful wood carvings made by the Bush Negroes, so that the people of my country can see how the people of your country live, and what beautiful things they make."

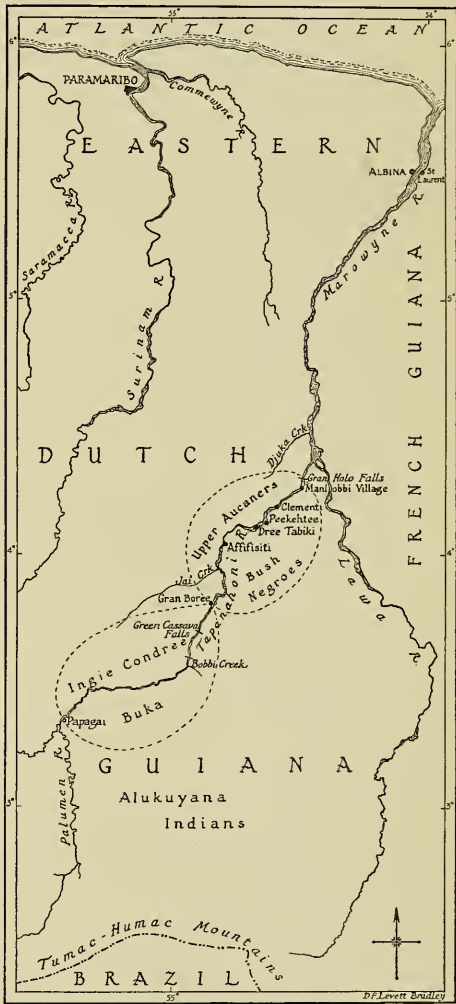
At this point, I passed around several photographs taken on previous expeditions. These were received with many exclamations of amazement, especially since some of the persons in the pictures had since died.

Kanapé then turned and looked me full in the face, saying, "White man I can see by your eye that you tell the truth." He then turned to the assembled Captains, and said: "You see the white man and you have heard him talk. He is not a stranger among us but has come to our people before. He has also travelled in the land of other tribes of Bush Negroes. He knows the Paramacca, the Boni and the Saramaccaner. You hear what he says, he wants nothing from us, but works to do us good. He wishes to go among the villages of our people, even to Gran Boree, the very farthest village of our nation. What is your pleasure?" etc.

"This white man is all right"

After each few words, Kanapé would pause and listen to the exclamation of his council. Such phrases were forthcoming as "*E-yah Granman*"—"Datti Bon"—that is good; "*you tahki true*"—you speak the truth; "*Kwet-Kwetti*"—not at all; "*Dissee Bahkra Dehbon*"—this white man is all right, as well as other nasal and guttural exclamations of an affirmative nature. The *Krutu* was finally ended by permission being granted to me as signified by all of the Captains clapping their hands in unison and nodding their heads.

Anticipating favorable judgment I had already begun to unpack my medical kit and had the necessary material ready for the purpose of making tuberculin tests, and also for extracting blood. I then said: "Granman since you are the head man of this tribe, it is only fitting that you should be the first to receive these tests." He demurred for a few seconds



REGION VISITED BY DR. KAHN

but being surrounded by the chief Captains, it, of course, would not do for him to show any signs of cowardice. And more or less to simplify matters, I gently seized his arm, rubbed it with alcohol, and applied the tuberculin test. A necessary sample of blood was obtained in a similar manner. As I was performing the

test on Kanapé the entire council laughed in high amusement and after that it was a simple matter to make similar injections on practically the entire tribe.

Without going into the theories involved, it can be said that the tuberculin test shows the Bush Negroes to be remarkably free from infection with the tubercle bacillus. They stand a marked contrast in this respect to the North American Negroes, their blood brothers, who show relatively high infection. This is especially interesting in view of the fact that the ancestors of the Bush Negroes came into contact with tuberculosis in the days of slavery, for it may indicate that life in the natural state, coupled with their isolation has enabled these people to throw off any manifestations of the disease which their forebears might have picked up.

Mr. Donaldson set about his task and obtained a number of most interesting motion and still pictures. Mr. E. W. Rogalli was of inestimable aid to both Mr. Donaldson and myself. After completing our work in one village, we went higher up the river to the next one and then on to the next. Opportunity was also taken to enhance the collection of Bush Negro art work now at The American Museum of Natural History, and also to gather further information concerning the life and customs of these people.

In this way, all of the villages of the upper Aucaners were visited. At a few places where the settlements were adjacent, the people from one village would come into the field headquarters which had already been set up in another. And at last we came to the most remote of all the Bush Negro settlements in Dutch Guiana, the village of Gran Boree, high up the Tapanahoni River, past the mouth of the far Jai Creek.

Unknown Indians

Late one afternoon while attempting to do some fly-casting from the shore, I happened to glance up the river and to my surprise saw three canoes coming down. I knew immediately that these were not Bush Negro dug-outs as the construction was entirely different. As the crafts came a little nearer it at once became apparent that the occupants were Indians, and from their appearance quite the wildest looking specimens that I have ever

seen. The red men saw me at about the same time. One of them gave a loud guttural command upon which the entire flotilla headed about and paddled full speed up the river from whence they had come.

In friendly pursuit

I dropped my fishing rod upon the rock and ran as fast as I could up the jungle trail to the village. Although I had seen the Caribs and Arawak Indians, who dwell closer to the coast, also the Akawoi and Wapisianas of British Guiana, it had never been my good fortune to encounter these wild tribesmen of the all but unknown interior, and I did not wish to miss such an opportunity. Fortunately, some of the members of my Bush Negro crew were about, and the story which I told as rapidly as possible was greeted with loud laughter. "Of course they ran away, they are very much frightened of white men. They call white men 'Panacheeree'—or those who kill their friends. They call us 'Micolo,' their name for Bush Negroes. Most of them have never seen a white man before but have heard some very bad stories about them. They are members of the Alukuyana tribe. Their country begins four days paddle from here at the mouth of the Palumen River (which drains into the Tapanahoni) and extends up the Palumen for many miles. The region between this village and the mouth of the Palumen is known as 'Ingie Condree Buka,' the mouth to the Indian country—no one lives there, so it was agreed upon many years ago by our chiefs and theirs. We will paddle after them with presents and try to induce them to visit you here. If they come be very gentle and do not make quick movements. Go to your hut and wait. If they come, give them rum and cigarettes, which they will like."

With these proud instructions in mind, I sat patiently at the door of my hut, but it was not until about 9 p.m. that I was able to make out a few dim figures crossing the village clearing. These proved to be Moiman and N'angoto, two members of my Bush Negro crew, each leading a stalwart red man by the hand, much as one would lead a child. I arose slowly from my camp chair and extended my hand to each of the Bush Negroes, and then to the Indians, who seeing what was expected of them shook it limply but gravely.

These men were entirely nude excepting for a loin cloth and necklaces and bandoliers of animal teeth and shells. Each carried a bow some 5½ feet in length with arrows of nearly equal length. The heads of the arrows were made of hard wood and, as afterward proved to be the case, were poisoned with curare. They had long black hair, extending well over their shoulders, while their bodies and faces were painted with red, green and yellow pigment. One must admit that such specimens would satisfy any small boy's idea as to what a real wild Indian should look like no matter how hard to please such a boy might be.

After the refreshments had been passed about, the tension seemed to ease considerably and the Indians seemed much interested in examining my clothes, skin, and the various pieces of camp equipment which were about. The next morning about 11 o'clock, seven more Indians came into our camp and from that time on we had little difficulty in making them feel at home. Larger bands were encountered by us when we proceeded up river some distance beyond Gran Boree to hunt fresh meat. This journey took us considerably beyond the Green Cassava falls, and to the mouth of the Bobbi Creek.

A no-man's land

The Indians come down to the remote Bush Negro villages to trade hunting dogs, bows, arrow shafts and feather work, for knives, machetes, cloth and sugar, which filter back into the Bush Negro country from the trading post of Albina, near the foot of the Marowynne River. Curiously, while the Bush Negroes are expert wood carvers they have not been able to make a bow which they consider comparable to those made by the Indians. The hunting dogs which look like a combination of hound and smooth haired fox terrier, are very highly prized and command a large price.

There is considerable traffic on this remote border, where red and black men meet. While the Indians cannot speak the "talkee-talkee" language of the Bush Negroes, nor do the Bush Negroes speak the Alukuyana dialect, they have developed a language known as "Mocks-Mocksie," in which a sign language is aided by a few words from both tongues.

One day while sitting outside of my hut, old Kanapé came to me with a spear having a

blade of hardwood 14 inches long and two inches wide at its widest part. The shaft of the spear was broken.

"You see this, Abentee (my Bush Negro name)," said he. "Just last year three Alukuyana Indians brought this down to me, the blade was covered with blood. The shaft of the spear was broken as you see it. This was a message from their chief to help them in their war against the Trio Indians. Those Indians! Their temper is quick and their head is hot. They fight each other for the least little thing. The Alukuyana and the Trio have war one against the other, and then sometimes after peace has been made both combine to fight the Saluma or Diau tribe, who live even beyond the Trio country. It is seldom that all tribes are at peace, but sometimes that is so. All the tribes are friendly with my people, and even in time of war a Bush Negro can go among them without fear of harm. Often I send my most able statesmen to make peace among them but many moons do not pass until some stupid minor incident causes hostilities to break out anew. This has been going on as long as my people have been on this river. In the early days, we also had our trouble with the Indians, but they soon found out that they were no match for us."

In these words you have a summary of the attitude of this group of Bush Negroes to the tribes of redmen who are their neighbors. The white man plays no part in this unusual borderland between two races.

The lost Redfern

It was in this part of South America that the gallant young aviator Paul Redfern has been supposed to be living. It may be of interest to recount some of the information I gathered concerning his possible whereabouts. As will be remembered, Redfern took off from Brunswick, Ga., in the summer of 1927, in an attempt to make a non-stop flight to Rio de Janeiro. There is no question but that he took fresh bearings from a ship off the coast of Venezuela, and there is good reason to believe that the aeroplane which was heard going over mission stations in British Guiana shortly afterward was Redfern's. After that nothing more was heard. Many reports have since filtered out from the interior of a white

man living with the Indians and Redfern's brave father has never lost hope of his son being alive and some day being restored to him. Some claimed to have actually seen Redfern in this or that Indian village, while others claim to have found pieces of aeroplane wreckage, wing fabric, the hat of the aviator, etc. As far as I am aware, none of these reports have been substantiated.

In view of the fact that my expedition was within a very short distance of the Palumen River in the upper country of which Redfern was last reported to be located, I took particular pains to ask the Indians who inhabit this region, also certain Bush Negroes who visit the Indian country, of the possible whereabouts of a lost white man. Their response convinced me that the possibility of a white man being in the very far interior is not entirely remote but whether such a person will prove to be the missing aviator is quite another matter.

Various reports

In the village of Dree Tabiki, I saw and spoke at great length with the Bush Negro Kau-flay, whose name has appeared in the news in connection with Redfern. Kau-flay went to the end of the Palumen River and walked twenty days further into the Indian country. He saw and spoke with the Indian Chief Sapuconu, in whose village Redfern had been reported to be. Sapuconu told Kau-flay that he had heard of a white man falling out of the sky and that such a white man was reported living with Indians even further in the interior. Sapuconu himself had never seen this man as has been reported. I also spoke at length to Negro dog traders, namely Payé (Paje), a most intelligent chap, and Captain Tattoo, who had accompanied me on a previous expedition. They had penetrated far into the Indian country from different directions. They encountered numerous Indians of the Alukuyana and Trio tribes, all of whom had heard the story of the white man but none of whom had actually seen him. It was my good fortune also to speak with Mr. M. A. Melchert who is in charge of the most remote mission station in Dutch Guiana. It was to Mr. Melchert that the Indian Kopan first told the story of a white man living in the village of Sapuconu. As has been indi-

cated, this rumor later proved unfounded.

It was from an Alukuyana Indian by the name of Awaimat, whose home is on the high Palumen River in the village of Tulu that I received the information about this white man who may be Redfern, that I considered the most authentic. Awaimat told me that his brother had actually seen this white man living in the village of Asunanga in the country inhabited by the Saluma (Saloma) tribe of Indians. This territory is on the western side of the Tumac-Humac Mountains across the Dutch Guiana border in Brazil. It is on the Hona-Wau Creek near the source of the Trombetas River, which finally drains into the Amazon. Awaimat appeared to be a man of about 45 years of age. He seemed to be in command of his band of men and impressed me as a reliable person and of good judgment. He stated further that this white man had fallen from the sky, and as he made the appropriate gesticulations he also made a noise like the humming of an aeroplane motor. Awaimat said that this white man's legs had been injured, but are now healed. Awaimat also stated that if the Saluma Indians saw white men coming they would be very liable to move even deeper in the interior. It is my impression that an attempt to reach this wild region, most of which no white man has ever seen, would be highly impractical if penetration were attempted from the Dutch Guiana side. It would seem more reasonable to reach the Hona-Wau Creek by going up the Trombetas River from the Amazon.

Two search parties

The stories I heard made it clear that if Redfern is among the Indians they are not treating him as a god, but do recognize that he is a white man. There are two expeditions now in the field to determine his possible whereabouts.

My expedition, which was conducted under the auspices of Cornell University Medical College, the American Museum of Natural History and the National Tuberculosis Association, penetrated this shadowy region primarily for scientific purposes. And the problems for investigation here are manifold, for in the entire world there is no other border where wild men of the black and red races meet on terms of aboriginal equality.



Where Black Man Meets Red

Dr. Kahn at the village of Loca Loca making plans for his expedition into the interior of Dutch Guiana: a journey for purposes of medical and anthropological research. The program included tuberculin tests and blood grouping of the little-known Alukuyana Indians and on the Bush Negroes, who dwell

far from their original West African home (Below) The two white men who assisted Dr. Kahn on the expedition: Mr. E. W. Rogalli of the Dutch Guiana Government Service, with thirty years of South American experience back of him, and Mr. Ralph Donaldson, in charge of motion pictures





(Above) Native paddlers: some of the twenty-two husky Bush Negro rivermen who manned the five 40-foot dug-out canoes

(Right) Poling through the tropical rain against a strong current



(Below) Rapids hinder progress throughout the entire length of the Tapanahoni River, the only avenue to the interior





(Above) The flotilla just after leaving Albina, a short distance above the mouth of the Marowynne River. Each canoe had a capacity of half a ton



It sometimes took the expedition three hours to go one hundred feet. Seventeen days of travel up-stream took the explorers to their highest point





Statuesque figures are common among the Bush Negroes



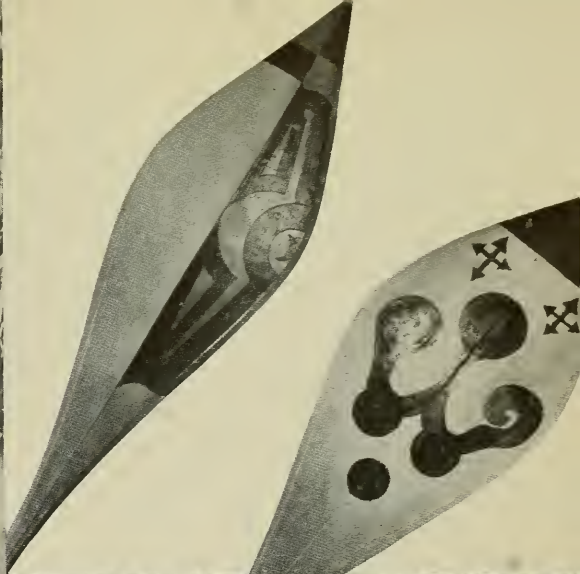
The Bush Negroes bathe often and are cleanly people. The unmarried woman wears only a short length of cloth, whereas the married woman's dress extends to the knees

Bush Negro rivermen with paddles bearing clan designs

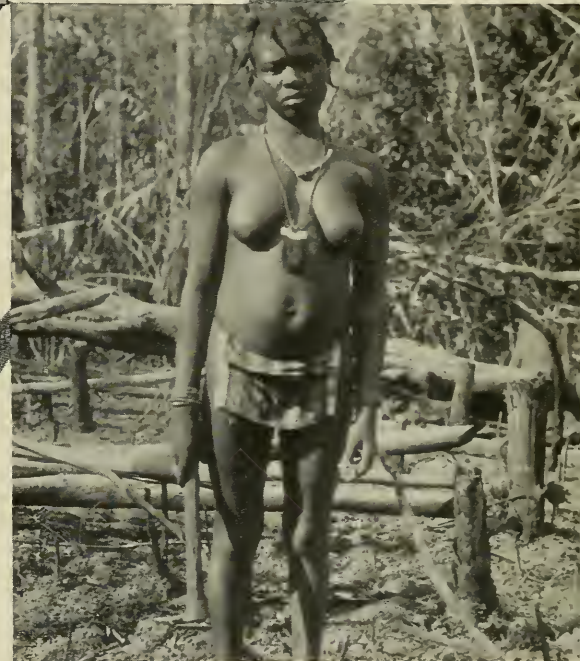




Bush Negro carving a tray out of a section of a tree trunk



Paddles. The Bush Negroes have a distinctive art which makes use of conventionalized, symbolic designs



(Above) A woman of the Aucaner tribe. The women tend the crops after the men have cleared the ground. Upland rice and casaba are the chief crops



Ornamentation of the skin by scarring such as the girl at the left shows is a direct West African survival. Both sexes adorn themselves in this way



A Bush Negro in his home; beside him are a fire fan, a carved tray and a mortar. As the logs burn they are shoved in toward the center. The tripod is used to support cooking vessels. This man, Moiman ("nice fellow"), accompanied Dr. Kahn on several expeditions



Common objects are fashioned by the Bush Negroes into elaborate objects of art

Clan designs on paddles. The Bush Negroes are divided into six tribes and numerous clans. They marry between clans but never outside their own tribe



(Below) A native weaving a thatch of palm fronds for his house





(Above) Enshrined fetiches in the village of Gran Boree. It is here that all the sacred objects of the tribe are kept because it is the most remote village of the tribe

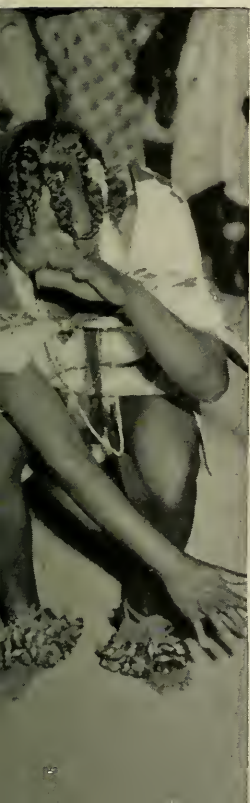
(Above) The shrine to the Voodoo or snake god, the most sacred symbol of the Aucaner tribe. It was only after a long krutu or pow-wow that permission was granted to photograph this object





(Above) Another difficult photograph to secure: a sacred drum, the ageeda, used to summon the spirit of the Voodoo or snake god

(Below) A member of the remote Upper Aucaners smeared with a sacred white clay that is used by these people whenever they feel the influence of religious emotion



(Left) A harvest dance in a wild section of Dutch Guiana. The anklets are made of Kau-e seeds. The orchestra consists of three tom-toms, rattles (saka), and a board of hard wood beaten with two paddles called quaqua





Dr. Kahn performing tuberculin tests. The tests showed the Bush Negroes to be remarkably free from infection with the tubercle bacillus. Life in the natural state, coupled with isolation, has apparently enabled these people to throw off any manifestations of the disease which their forebears may have contracted while enslaved



New information on the possible whereabouts of the aviator Redfern: Payé, the Bush Negro dog trader, relating the story of the white man who fell from the sky as he heard it from the Trio Indians farther inland

Indians who had never before seen a white man: a flashlight photograph of two Alukuyana Indians. The beliefs and customs of these people are unknown. They live almost entirely by fishing and hunting, and in the latter pursuits even the Bush Negroes acknowledge them their superiors



Dr. Kahn with three Bush Negroes and four Alukuyana Indians (with long hair). This remote section of Dutch Guiana is the only place in the world where wild men of the black and red races meet on terms of aboriginal equality. Many years ago there was trouble between these groups, but today they are on good terms



Three Alukuyana Indians and a Bush Negro. The Indians train dogs for hunting and bring them down the river to trade with the Negroes for knives, axes and machetes. Dr. Kahn's tests on seventy of the Indians showed them to be entirely free from infection with the tubercle bacillus



The Indian who gave Dr. Kahn the most authentic information that may relate to the lost aviator Redfern. Awaimat stated that a white man had fallen from the sky and was living in the village of Asunanga beyond the Tumac-Humac Mountains in Brazil, and that his brother had seen him



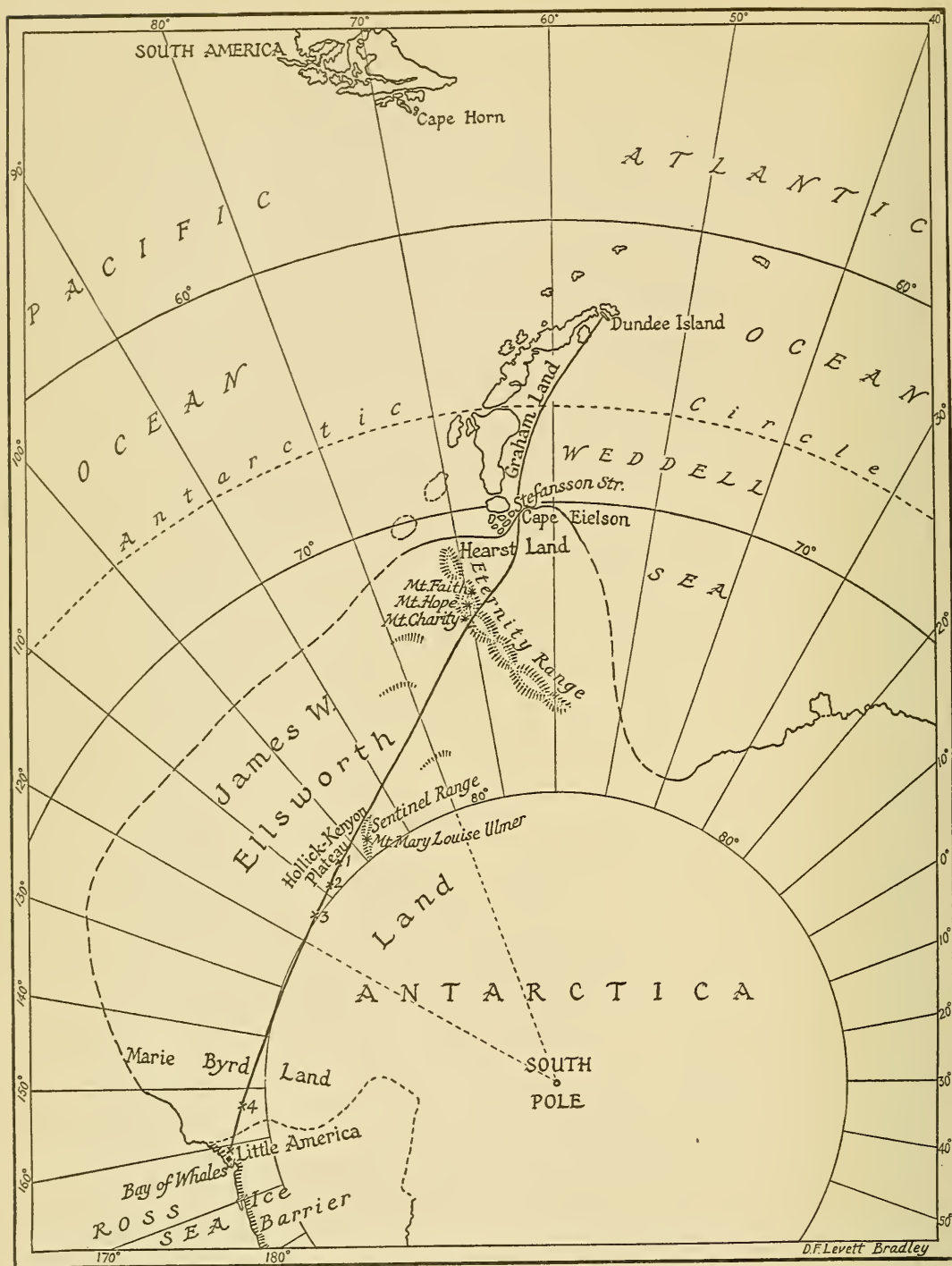
Wide World Photos

LINCOLN ELLSWORTH

Ellsworth's Own Diary

The wonder of discovery revealed in a document that chronicles, minute by minute, the exploration of an unknown world

Date	G.M.T.	Local Mean Time	Remarks
Nov. 23rd	03.00	22nd 11.16 p.m. (Long. 56° W. = -3 ^H 44 ^M)	Left "Wyatt Earp" at ice edge of Dundee Is. for 500 foot climb to where "Polar Star" stood groomed and ready for trans-Antarctic flight.
Nov. 23rd	08.04	4.20 a.m. (56° W. = -3 ^H 44 ^M)	Took off in "Polar Star." Headed south following east coast already explored Graham Land. Weddell Sea observed to be quite open to about Lat. 69 south.
Nov. 23rd	12.22	8.6 a.m. (64° W. = -4 ^H 16 ^M)	Crossed Stefansson Strait. Confirmed Wilkins' discovery of a separation between Graham Land and the Continent of Antarctica, but observed Strait to be not more than one mile wide, which is much less than is shown on maps. Compass bearing of coast S.E. 138° and W. 242°. Low black conical peaks of Cape Eielson on our left. Climbed to elevation of 13,400 feet, temp. minus 22° cent. Heading for the unknown. Bold and rugged mountain peaks across our route lay ahead, some of which seemed to rise almost sheer to 12,000 as far as the eye could see. I named this range "Eternity Range."
Nov. 23rd	14.25	9.45 a.m. (70° W. = -4 ^H 40 ^M)	Passed three prominent peaks of Eternity Range on our right. I named them "Mt. Faith," "Mt. Hope" and "Mt. Charity." Saw no glaciers or crevassed surfaces.
Nov. 23rd	15.30	10.42 a.m. (72° W. = -4 ^H 48 ^M)	Mountains beneath us dwindled out into isolated nunataks and merged into a great snow plateau surface with elevation of between 6000 and 7000 feet. Isolated patches of sastrugi appeared at intervals on our right, but no crevasses.
Nov. 23rd	16.15	11.11 a.m. (76° W. = -5 ^H 4 ^M)	On distant right horizon a mountain range became visible with isolated black peaks which faded out 20 minutes later.
Nov. 23rd	17.00	11.32 a.m. (82° W. = -5 ^H 28 ^M)	A few more peaks showed on same horizon.
Nov. 23rd	17.20 17.45	11.44 a.m. (84° W. = -5 ^H 36 ^M)	Mountains 120 to 140 miles distant appeared on our left horizon, also a few peaks on our right horizon.
Nov. 23rd	18.20	12.16 p.m. (91° W. = -6 ^H 4 ^M)	Very hazy ahead. It was dead flat with a patch of sastrugi on our left. 110 miles further on came a beam of a solitary little range about 75 miles long on our left to which I took bearings. It was symmetrically formed with peaks rising to 13,000 feet. and all clustered into a central mass which dwindled down at either extremity to merge into a plain around. I named it "Sentinel Range" and its central peak "Mt. Mary Louise Ulmer" after my wife.
Nov. 23rd	19.30(?)	12.58 p.m. (98° W. = -6 ^H 32 ^M)	



LINCOLN ELLSWORTH'S FLIGHT, 1935

Between November 23rd and December 15th Lincoln Ellsworth flew from Dundee Island to Ross Sea, traversing an unexplored section of the Antarctic continent. The 2100 mile

flight was broken by four landings as shown. Much territory was explored, and the section between 80 and 120 degrees west longitude was claimed for the United States.

Date	G.M.T.	Local Mean Time	Remarks
Nov. 23rd	19.45 (?)	1.5 p.m. (100°W.= -6 ^H ₄₀ ^M)	Fifteen minutes later on south horizon, 100 miles distant, appeared a long black-tipped range which visibly extended through at least one degree of latitude. This appeared to be the last of the mountains we were to see, for ahead and around swept only a vast plateau meeting the horizon in a vista of white. Our visibility on the journey thus far had been from 120 to 150 miles, for we were flying at an average height of 10,000 feet in clear weather.
Nov. 23rd	21.55 (First Landing)	2.59 p.m. (104°W.= -6 ^H ₅₆ ^M)	Visibility getting low. Landed after 13 ^H ₅₀ ^M flying and fixed our position as Lat. 79°12'S. Long. 104°10'W. Altmetre showed surface elevation as 6400 feet, and the plateau extended, with slight undulations, in every direction. We stood on the only unclaimed land in Antarctica; in the whole world in fact. With permission of the Department of State I raised the American flag and named this area between Hearst Land on the one side and Marie Byrd Land on the other, or between the meridians of 80° and 120° West longitude, "James W. Ellsworth Land," after my father who made the flight possible. The plateau, above 6000 feet, upon which we were, I named "Hollick-Kenyon Plateau," after my pilot. Remained in this camp till November 24th.
Nov. 24th	5.03 (Second Landing)	—	Took the air again, but landed 30 minutes later in Lat. 79°30'S., Long. 107°55'W., due to low visibility. Elevation about 6400 feet.
Nov. 27th	— (Third Landing) 23.55	11.10 p.m.	Took off and landed 50 minutes later (midnight) in Lat. 79°58'S., Long. 114°15'W., just as such thick weather enveloped us that we could barely see to land. No sooner had we pitched our tent than a blizzard broke upon us. For three days we lay in our sleeping bags trying to keep warm and save fuel. Temp. -5° Fah. This point seemed to be about the end of the level plateau which had extended from the last seen mountains.
Dec. 4th	19.15	11.38 a.m. (114°15'W.= -7 ^H ₃₇ ^M)	Took off.
Dec. 4th	20.30	11.58 a.m. (128°O'W.= -8 ^H ₃₂ ^M)	One hour and a quarter later, and about 140 miles after taking off, at an elevation of 4500 feet the plateau, with undulations, seemed to drop towards the Ross Sea Barrier.
Dec. 4th	22.04	12.24 a.m. (145°O'W.= -9 ^H ₄ ^M)	In longitude 145°W. we were over crevasses and 36 minutes later we estimated the surface to be at an elevation of about 1000 feet.
Dec. 4th	23.10 (Fourth Landing)	12.57 p.m. (153°16'W.= -10 ^H ₁₃ ^M)	Landed. Elevation 980 feet, Lat. 79°15'S., Long. 153°16'W. Camped for night. 125 miles from Bay of Whales.
Dec. 5th	—	Early a.m.	Took off.
Dec. 5th	—	10.3 a.m.	"Polar Star" slackened in her speed, and like a weary bird gently came to earth, completely out of gas. We dug trenches for the ski, weighted them down with some of our equipment and then pitched one tent. We knew that we were not far from Little America. One day Kenyon, standing on the wing of the

Date	G.M.T.	Local Mean Time	Remarks
			plane and looking ahead, saw what he thought to be Little America. Yes! There it was, the wind generator coated in ice and a long line of snow-covered objects which must be the houses—and only 4 miles away.
Dec. 9th	—	—	<p>Packed hand sledge with three weeks' rations. We started out wearing 3-foot snowshoes, and well we did, for drawing a sledge over the ice-coated sastrugi surface we never should have gotten any place with ski.</p> <p>The four miles proved to be fifteen, and instead of Little America we came to only a pinnacle of ice in the midst of a huge pressure ridge. We had left the plane without tent or sextant, hoping to find shelter in Little America. Leaving our sledge, we started back for those two necessary items, rested an hour at the plane and then started back for the sledge. The snow was soft and wet and the sun beat down out of a cloudless sky and made us sweat for the first time during the 22-day journey. Because of heavy hauling we decided to sledge by night and sleep by day, but good weather only lasted two days, then turned foggy. For the first two days we travelled west, then north. Kenyon took bearings with his pocket compass and we estimated our speed to be two miles per hour. We would pull for fifteen minutes, then rest for four, and so on we went, calling 6 hours a day's work.</p>
Dec. 12th	—	—	Overcast and misty. We had made 12 miles and I pointed ahead to where a dark streak broke the dull vista of endless white. It could only be one thing—open water—we both agreed. We pitched our tent, intending to reach it next day.
Dec. 13th	—	—	We looked out of the tent to see everything enshrouded in mist. We travelled all day in the direction we thought the open water lay, but it seemed we were never again to get a glimpse of it. At noon we rested. In the late afternoon through the mist we could discern the crest of a ridge, and thought it odd on the flat barrier surface. We hastened our march. We heard what we imagined to be the lapping of waves. We mounted the ridge and looked straight down into the Ross Sea and were standing on the very edge of the Great Barrier. We retraced our steps and camped for the night about a mile back, for the barrier face is always breaking away. We didn't want to be dumped into the sea just as our goal had been reached.
Dec. 14th	—	—	Morning observations put us about 15 miles north of Little America. We had evidently passed it in the thick fog, so back we must trudge. We found later that we had been three miles east of the eastern end of the mouth of the Bay of Whales. The Bay itself had not begun to open as yet, and a wintry scene indeed it looked. We remained in camp all this day.
Dec. 15th	—	—	Followed the edge of the Bay of Whales and reached Little America just 22 days after leaving Dundee Island.
Jan. 16th	—	8 p.m.	"Discovery II" arrived Bay of Whales from Melbourne with relief.
Jan. 22nd	—	5 p.m.	"Discovery II" left Bay of Whales, departed for Melbourne.

The U.S.S.R. in the Arctic

A new page in the history of the North, showing how supposedly worthless lands can be made habitable and productive

By S. S. SHIPMAN

IN September, 1935, brief press dispatches from Moscow reported to the world that four freight steamers had succeeded in linking the Atlantic and Pacific Oceans by voyages across the frozen Arctic.

Two of the vessels, the "Vanzetti" and the "Iskra," made the West to East journey from Murmansk to Petropavlovsk, on the Amur River, while the "Anadyr" and the "Stalingrad" sailed from Vladivostok to Murmansk. All four ships, built in the U.S.S.R. of Soviet materials, carried large cargoes of foodstuffs, clothing, fuel, and supplies for the population of the extreme North. The "Stalingrad," after completing her record-breaking journey to Murmansk, went on to London to establish a new trade route from Asia by way of the Arctic.

A new era

Behind the prosaic words of these reports is a drama of the North—the culmination of years of struggle to open up the Northeast Passage for commercial navigation and to develop the great natural resources of the white Arctic continent of the Soviets. For a veritable continent it is—constituting about 40 per cent of the huge expanse of Russia and an area at least fifteen times as large as France.

It is a drama punctuated by heroic exploits of ice-breaker expeditions, by daring airplane rescues, by tales of little groups of explorers and scientists pursuing lonely vigils, sometimes lasting for years, in remote Arctic outposts. It is a drama in which human courage and persistence, armed with the tools of modern science, have conquered the snow and ice of the Arctic. Exploration and development in the

Arctic today, backed by the resources of the State, bear the same relation to the largely individualistic efforts formerly traditional in Arctic exploration that the "Normandie" bears to the sailing vessels of the nineteenth century. It is possible that more has been accomplished by the U.S.S.R. in the Arctic in the past ten years than by all other countries together since the beginning of the past century.

Planes aid ships

The manner in which the journey of the four freight steamers across the Arctic was accomplished last summer was a practical demonstration of how, by mobilizing the various technical means now available, it has been possible to master the unknown North. Four powerful ice-breakers were stationed in the most difficult sections to convoy the freighters through the heavy ice. Scouting airplanes went ahead to survey the route and relay back to the vessels and to polar stations radio reports on weather and ice conditions. With this assistance the steamers were enabled to navigate thousands of miles of pack, frequently enveloped in dense fog. The voyages, scheduled for five months, were completed in little over half that time.

As a result of numerous such episodes, a new life has come to the Arctic. Where formerly polar bears roamed about and seals crawled over drifting floes, Soviet geologists, explorers, and workers are living, building and making studies. At present about thirty thousand persons of various occupations and callings live and work in the Arctic regions, and the number is steadily growing. Scores of radio stations in the far North transmit to Moscow regular reports of meteorological con-

ditions. Surveying parties have uncovered valuable deposits of coal, oil and metals. Sea and river ports have been built, and new industrial centers created. Dozens of vessels now sail the Arctic waters and airplanes wing their way freely over the uncharted wastes. New islands have been discovered and "blank spaces" on the map filled in. In the words of Rudolph Samoilovich, famous Arctic scientist, "life is everywhere. Like a spring it bubbles in the lands of the Soviet Arctic, and the day is not far distant when the Arctic will cease to be a land of adventure and will become an integral part of the country."

As early as 1919, when the northern regions were still occupied by foreign armies, Soviet leaders were laying their plans for harnessing the Arctic wastes. A first expedition to Novaya Zemlya (New Land) in 1921 was followed by a series of explorations around that island and in other parts of the Western Arctic, especially Franz Josef Land. Another early expedition set out from Belushia Bay, on the west coast of Novaya Zemlya, in July, 1923. The party of four men sailed in a 25-foot boat equipped only with a mainsail and a five horsepower engine. The chief combined the functions of captain, sailor, geologist and topographer. It is interesting to compare this expedition with those of recent years, with as many as 150 scientists and workers in one expedition, commanding all the resources of modern Arctic science and navigation—ice-breakers, planes, radio, etc.

The "Krassin" to the rescue

The first big test for the Arctic forces of the U.S.S.R. was the rescue in 1928 of the hapless members of the Nobile polar expedition from the dirigible "Italia" by the ice-breaker "Krassin."

On May 29, 1928, radio stations in North Russia picked up the S.O.S. of the "Italia." The ice-breaker "Krassin," the largest in the world, sailed June 15 from Leningrad toward the west side of Spitsbergen, from the vicinity of which the radio signals had come. At the same time the icebreaker "Malygin" was dispatched from Archangel toward the eastern shores of the group. By July 10, the "Krassin," after slowly ploughing through the crushing ice, was within sixty miles of the marooned flyers. Her aviator, Chukhnovsky,

in a daring flight over the Arctic wastes, spotted two of the survivors. In his return flight, he was forced down by heavy fog, damaging his plane in landing. Two days later, the "Krassin" picked up from the ice Zappi and Mariano (whose companion, the Swedish scientist Malmgren, had died) and the same day took aboard five more of the Italian survivors. Then the party searched vainly for a third group of seven Italians who had been blown eastward when the gondola broke loose from the ship; effected the rescue of Chukhnovsky and his companions; relieved the Italian group who had made their way overland by dog-team to seek aid, and, finally, carried on a search for the famous Norwegian explorer, Amundsen, who had disappeared in the sea without leaving a trace, somewhere between the coast of Norway and Bear Island.

Northeast Passage in one summer

These and several later expeditions were preludes to the memorable voyage in 1932 of the ice-breaker "Sibiryakov," the first ship to complete the Northeast Passage in a single navigation season. For 400 years scientists and navigators had been trying unsuccessfully to find a short route to India and China through the northern seas. It was not until 1868, that the Swedish explorer, Nordenskiöld, was able to get through this passage at all, after first being compelled, however, to spend a winter near Bering Straits. The only expeditions to make the journey since were those of the Russian Vilkitsky, in 1914-15, who spent one winter in the ice, and of Roald Amundsen (1918-20), who was forced to winter for two years before finally breaking through. The "Sibiryakov" made the passage in two months.

The expedition, under Commander Schmidt, left Archangel July 28. After sailing around the northern shore of Northern Land—the first time that this had ever been accomplished—they encountered heavy ice, sometimes over thirty feet thick. Battling the pack ice, several propeller blades were broken, the engine was put out of commission, and, finally, the propeller shaft broke off, taking with it the propeller. The vessel drifted eastward with the heavy ice floes. When the ice began to thin out, home-made canvas sails were put up, and taking advantage of the favorable winds and the

current which she had now succeeded in reaching, the ice-breaker slowly made her way toward Bering Sea. Sometimes in order to make headway it was found useful to cast anchor in the ice and kedge the vessel forward by means of a winch. At times explosives were used to blow up the largest and most unyielding ice masses. Thus, in one way or another, but through her own efforts, the "Sibiryakov" reached open water in the Bering Sea on October 1. This unprecedented journey demonstrated that with proper technical equipment it would be possible to establish regular commercial navigation through the northern sea passage.

As the efforts of Soviet explorers were now directed toward the opening up of the Northern Sea Route for practical commercial purposes, it was decided to repeat the voyage of the "Sibiryakov" with a commercial vessel. Accordingly, the "Cheliuskin," a specially built 4,000-ton freight steamer, constructed with some ice-breaker features, was dispatched from Leningrad on July 18, 1933. This journey, although ending in the sinking of the vessel, proved to be one of the most noteworthy in the annals of Arctic navigation. The expedition was led by Professor Schmidt, head of the Northern Sea Route Administration. Its 105 members included many of the members of the "Sibiryakov" expedition. There were also on board ten women and two children (one of whom was born as the steamer battled its way through the ice of the Kara Sea), making up the families of a party of scientists who were to replace the group wintering on Wrangel Island. By September they had reached Cape Cheliuskin—about midway along the bleak Arctic coast line and the northernmost point of the continent. Twelve vessels were gathered at the mouth of the Lena River, whereas in the entire previous history of Arctic navigation only nine ships had ever reached that remote port.

A miss as good as a mile

At about 250 miles from Bering Straits heavy pack ice was encountered and progress became painfully slow. After 18 days of alternately buffeting and drifting with the ice the vessel was actually in sight of Bering Straits and open water on November 3. But before the last 15 miles of heavy ice could be

negotiated a fierce gale blew up and swept the ice masses in which the "Cheliuskin" was caught fast far to the northwest. For three months the vessel struggled against the heavy ice fields and on February 13 a wall of ice thirty feet high crashed against her and split her side from bow to stern. In the two hours that it took the ship to sink, provisions, building materials and supplies and the entire party on board—with the exception of one man crushed by a beam—were safely landed.

Then followed the amazing series of rescue expeditions organized by the Soviet government, by air, land and sea. Airplanes were dispatched from all parts of the Arctic; dirigibles were sent by rail and boat as a reserve; dog-team bases were established at the nearest points along the shore with supplies of food. As a final measure the ice-breaker "Krasin" was overhauled at Leningrad and sent on a 12,000-mile voyage through the North Sea, across the Atlantic Ocean, through the Panama Canal and up the west coast of North America to the Bering Sea. By the time the vessel reached the Canal Zone all of the 104 persons on the ice floe had been rescued by seven airplanes, after a series of spectacular flights in which fogs, blizzards and masses of moving ice on the improvised landing-fields and other hazards were successfully overcome. The women and children were taken off the floe on March 5 but it was a month before other planes could arrive at the scene and make their way to the marooned group. The last six persons were carried to the mainland on April 13, exactly two months after the sinking of the vessel.

Victory out of defeat

The "Krasin" arrived in time to transport the rescued members of the expedition from the Chukotsk Peninsula to the steamers which carried them to Vladivostok on their triumphant homeward journey. Then the ice-breaker headed for Wrangel Island to relieve a party which had been operating the least accessible polar station in the world. This group, including a woman explorer, had been on the island for five years, since for that entire period the ice had been too heavy for any vessel to plow through. While waiting to be carried back to civilization the party put their spare time to good advantage, collecting 2,000 fox skins, 600

bear skins and tons of ivory mammoth tusks.

That summer the ice-breaker "Litke" for the first time in history completed the west-bound voyage from Vladivostok to Murmansk in a single navigation season.

The year 1935 marked the turning point from the stage of experimental journeys to that of regular navigation on definite schedules. During that season eighty-five vessels sailed in different parts of the Arctic, carrying cargoes totaling 500,000 tons.

Commerce in the Arctic

The most important commercial voyages are those on the Kara Sea, through which vessels carry freight, principally lumber, from the mouths of the Ob and Yenisei Rivers in north-western Siberia to western Europe. The Kara Sea expeditions started in 1921 and the volume of shipping has grown steadily from five vessels carrying thirteen tons that year to twenty-eight ships carrying 116,000 tons in 1934. In 1935, forty-five vessels participated in the voyage. These expeditions link up the vast expanses of northern Siberia and their great natural resources with the markets of the European part of the U.S.S.R. and of western Europe. The Ob and the Yenisei each extend for a distance of over 2,000 miles from north to south and with their tributaries tap a basin of about 2,000,000 square miles. Until very recently, with the establishment of regular all-year-round air schedules in the northern regions, these great waterways were the only links between the remote Arctic districts and the industrial and trading centers of the U.S.S.R.

The Kara Sea passage has a famous history, dating from the eleventh century, when daring river pirates occasionally ventured on errands of plunder to the mouths of the Ob and Yenisei Rivers. However, as late as the middle of the nineteenth century, the Kara Sea was looked on as an ice-bound prison from which escape was well-nigh impossible. In the thirty years from 1875 to 1905, only seventy-eight freight vessels penetrated into its icy waters. Regular navigation began in 1920 but it was not until ten years later that sufficient knowledge had been accumulated to permit of the publication of the first charts and sailing instructions. The voyages are no longer called

"expeditions" but "operations" which, although of short duration—the Kara Sea is open for navigation not more than 100 days a year—have attained the regularity of normal trading schedules. Besides Soviet steamers, ships from many other European countries now visit the new Siberian ports at the mouths of the Ob and Yenisei Rivers. British vessels accounted for two-thirds of the total tonnage in 1934.

Complete mastery of the Arctic route, from Archangel and Murmansk to Vladivostok, will relieve considerably the burden on the Trans-Siberian Railway and give a great impetus to the fur and fishing industries as well as to agriculture and cattle-breeding in the polar regions.

A leading role in the opening up of the Arctic to navigation has been played by the sturdy ice-breakers, which eat through almost the heaviest ice packs. The Soviet ice-breaker fleet, already the largest in the world, is being augmented by six powerful vessels recently put under construction. Four of these will have steam engines totaling 10,000 H.P. each, the same capacity as the "Krassin." Each will have emplacements for three airplanes and catapults to propel them into the air. Two Diesel-electric ice-breakers will have a capacity of 12,000 h. p. each.

Minerals

The army of scientists operating in the polar regions have proved that the Arctic territory, far from being merely a bleak waste of snow and ice, actually abounds in mineral wealth. A recent map shows the location of 273 deposits of useful minerals already discovered in the polar regions, including coal, peat, asphalt, oil, graphite, asbestos, gold, platinum, copper, lead, tin, nickel, iron and amber.

The expanse of dense taiga (forests) and tundras (marshy plains) along the Pechora River in the extreme northern Urals is becoming an industrialized territory. Several coal mines now supply fuel for vessels sailing on the Northern Sea Route and for Archangel and Murmansk. Oil derricks have been built and a new refinery is producing kerosene and gasoline at this most northerly oil center in the world.

At Igarka, on the Yenisei River, a bustling lumber port and industrial center of 20,000 inhabitants has been created amid forest and

frozen tundra. To build city and port, work was carried on in winter with the temperature sometimes down to 60 below zero. Now there are sawmills producing lumber for the Kara Sea operations, a fish cannery, a graphite plant, radio and meteorological stations, as well as schools and hospitals. The dreaded scurvy, which created havoc among the population several years ago, largely because the vegetables sent from Krasnoyarsk froze on the way and lost their vitamin content, has now been entirely overcome. Vegetables are now grown in hothouses artificially lighted and heated during the long Arctic winter.

A mushroom city

To exploit the famous apatite (phosphate) deposits of the Kola Peninsula, where a few years ago the entire population consisted of a few nomadic Laplanders roaming the snowy wastes with their reindeer, there has grown up the important industrial center of Kirovsk, with 40,000 inhabitants. For a month and a half there is virtually uninterrupted night, for a month and a half unbroken sunshine. The development of the apatite deposits has not only freed the U.S.S.R from dependence on imports but has converted her into an important supplier of phosphate fertilizer for world markets. In connection with the apatite mines and concentration plants, there has been constructed a 60,000-kilowatt hydro-electric station on the Niva River, the most northerly in the world. Thus the Arctic wastes are beginning to be dotted with towns, factories and ports.

The fish catch in the Arctic has increased from less than 1,000 tons in 1932 to over 5,000 tons last year. Canneries operating in the North now turn out about 2,500,000 cans a year. The seal catch is also steadily rising.

To increase and improve the breeds of fur-bearing animals special nurseries have been established. The most important are on the Commander Islands in the Bering Sea and the scores of islands lying in the vast expanse between them and the mainland. On these islands blue and red foxes, beavers, sables, spotted reindeer, are being bred by the scores of thousands.

For the first time in history large-scale farming is being developed in the polar regions. It has been found that the lack of heat

is compensated by the abundance of light. State farms in the Arctic last year cultivated over 6,000 acres of vegetables, including potatoes, carrots, beets, cabbages, onions, kohlrabi, peas, cucumbers and turnips. The anti-scorbutic vitamin "C" is now produced in abundance in the Arctic. Aside from Igarka, hothouse farms have been set up on Dickson Island and at Capes Schmidt and Wellen. Many Soviet scientists are working on the problem of developing northern varieties of plants. Seeds brought from all parts of the globe—from Canada, Alaska and South America—are crossed with the native varieties.

The Kirovsk Polar and Alpine Botanical Gardens, organized in 1932, studies the flora of northern regions. The gardens occupy an area of 3,000 acres, with extensive nurseries and flower beds. So far about 25 types of plants have been found which grow well in the far North, particularly the hardy fruits and berries developed by the famous Michurin.

Farming in the Arctic

The nomad natives of the Arctic—constituting in all twenty-six nationalities—were formerly entirely ignorant of plant culture. For the first time they are now planting fodder grasses and vegetables. This activity supplements deer-breeding, hunting and fishing, tends to adapt them to a more settled existence, and raises their standard of living.

Successful experiments have also been made in the breeding of livestock. Pigs stand the northern climate well, and when they were introduced at Igarka and Anadyr proved quite prolific. At Anadyr the native Eskimos, Chukchi and Kamchadals are beginning to go in for pig-raising and the local cooperative dairy is raising milch cows.

Experiments in cross-breeding the native reindeer have produced a domesticated animal that is in every way superior to the ordinary northern deer. The laboratories of the Lenin-grad Deer Breeding Institute have produced foods to supplement the moss and lichen ordinarily considered adequate for deer, as these have been found to lack certain nutritive elements. Serums to ward off diseases to which these animals are susceptible have also been prepared.

Almost the year round Russian fliers thread

their way to and from all parts of the polar regions. They accompany the Kara Sea expeditions and guide freight vessels on their journeys to the mouth of the Lena River. They participate in trapping and fishing expeditions, locating seal herds and fish schools and guiding the boats through the ice. They assist in geological surveys and mapping operations. They carry mail, freight and passengers on the several air lines that have been organized in the far North in the past few years. About two-score Soviet planes flew a total distance of 875,000 miles in the Arctic regions during 1935—over a dozen times as much as three years before.

New air routes

At present regular airways are already in operation along the valleys of the Ob, Yenisei and Lena Rivers. The 1,250-mile Krasnoyarsk-Dudinka line will shortly operate on a daily schedule throughout the year. Another service will extend from Khabarovsk through Anadyr, Cape Schmidt and across the Chukotsk Sea to Wrangel Island. Planes will make this journey of 2200 miles every ten days and for the first time Wrangel Island will have direct communication with the mainland all year round.

Within the next two or three years it is planned to have a network of mail and passenger airlines tapping the entire Arctic territory. Airplanes will be expected to cover the route from Murmansk and Archangel to Vladivostok, via the Arctic Ocean and the Bering Straits, in sixty hours' flying time.

The opening up of the new air routes in the polar regions was preceded by a series of daring experimental flights over almost unknown territories. The pilot Vodopianov flew from Moscow to Cape Schmidt, at the extreme northeast tip of Siberia, and back—a distance of about 12,500 miles—in 104 hours' flying time. In the last 3000 miles of the flight to Cape Schmidt, the stretch from Khabarovsk, the aviator had to wing his way "blind" through thick fog and mist over the open sea to Okhotsk and over the Anadyr Mountains.

An outstanding flight was made last summer by the pilot Molokov, a hero of the "Cheliuskin" rescues, over northern Siberia and the eastern section of the Arctic. Starting

from Krasnoyarsk, Molokov, using a specially equipped giant plane "U.S.S.R.N-2," flew east to Yakutsk. From there the route lay over the towering Kilima Peaks, never before conquered by plane, then north to the Arctic Ocean. For a month and a half the party of six made studies of the ice and meteorological conditions in the East Siberian and Chukotsk Seas. They then flew north of Wrangel Island to a latitude of 73°, the furthest north ever attained by a plane in that territory. It was here that the mythical Andreyev Land was supposed to lie, but Molokov reported that all that could be seen was a vast smooth expanse of ice. The plane covered a distance of 25,000 miles in 250 flying hours during an expedition lasting eighty-nine days, without a single mishap.

Radio plays a no less important part in the conquest of the Arctic regions, assuring every ship sailing the Northern Sea Route of continuous contact with the mainland. When the "Cheliuskin" sank the radio station was dismantled five minutes before the vessel disappeared in the icy sea. Within twenty-four hours the operator, Krenkel, had brought the Schmidt Camp in touch with the mainland, and the constant communication maintained made possible the subsequent rescues.

The aggregate capacity of radio stations in the Arctic was 20,000 watts in 1934, compared with 3050 in 1932. The schedule calls for putting into operation by the end of 1936 additional wireless stations with a capacity of 35,000 watts. There are now over 100 wireless stations in the Arctic and sub-Arctic territories, whereas in 1917 there were in all four radio stations in the Arctic.

Scientific work

Last year about two-score scientific expeditions were sent to the Arctic. Among the forty-nine special expeditions planned for 1936 will be one to study the White Sea herds of Greenland seals; another will study the sturgeon fisheries at Novaya Zemlya, and another will go to the Yenisei region to help develop the raising of muskrats. Over 400 scientific workers, including 150 geologists, will participate in the various expeditions.

An important and fruitful expedition was that aboard the ice-breaker "Sadko" last sum-

mer. Its fundamental tasks were to explore the course of the warm currents of the Gulf Stream and to make a hydrological study of the lower depths—two miles down—of the polar basin.

The "Sadko" had been raised from the bottom of the sea, where she had rested for seventeen years, in October, 1933. The expedition spent eighty-five days cruising in polar waters and covered a distance of 7500 miles. Half of this lay north of the 80th parallel. The highest point reached was $82^{\circ} 41'$, setting a world record for navigation in northern latitudes. The scientific observations embraced the territory from the shores of Norway across the Barents Sea, the Greenland and Kara Seas and the entire western part of the Arctic Ocean. The "white spot" on the map of the Soviet Arctic between Franz Josef Land and Northern Land—an area of 14,000 square miles, was filled in. Shallow water was found in the center of this area and one large and three small islands discovered near the shores of Northern Land. The expedition collected many thousands of species of flora and fauna, a great number hitherto unknown; made over 5000 chemical analyses of sea water; took 2500 soundings of the sea bottom; drew up ninety weather charts based on its own observations and on meteorological reports received two or three times a day from other stations; studied the ice-drifts, and mapped more precisely the outline of the coast of North Spitsbergen and other little known islands.

Radio-probes

The stratosphere was studied by means of radio-probes, which are automatically recording instruments sent up in little balloons. The readings of the instruments are automatically transmitted by radio. Thirty-three radio-probes were sent aloft, of which twenty-one reached the stratosphere. This instrument, invented by Professor Molchanov, is one of the most valuable devices for investigating the properties of the atmosphere. On occasions they have reached a height of fifteen miles in the Arctic regions and recorded the temperature and air current conditions prevailing. This radio balloon, which as originally designed weighed about three pounds, now weighs less than a pound.

Ushakov discovered a warm water lane 650 feet wide cutting through previously unexplored territory between Franz Josef and Nicholas II Land. The temperature of the water was 30° F. and Ushakov expressed the belief that it was a part of the Gulf Stream. Should this prove true the discovery may lead to findings of incalculable value to navigation in the northern seas.

The recent discovery by the "Malygin" expedition of six hitherto unknown islands in the center of the Kara Sea was received with great interest in view of a theory held by Soviet experts that at one time the entire territory from the Kara Sea north to Franz Josef Land and Northern Land was part of a continent which sank into the sea, leaving only the tops of mountains above water. The four islands discovered by the "Sadko" expedition are believed to be peaks of these submerged mountains.

Arctic museum

To popularize the scientific and economic achievements in the Arctic, there is to be opened this year in Leningrad the first Arctic Museum. Exhibits will show the natural resources of the polar regions, and display interesting relics, including some objects left by the explorer Barents, who spent a winter beyond the Arctic Circle in the year 1596. These were buried under the snow for over three hundred years. Notes written by Roald Amundsen on his expeditions of 1918-19 also constitute a part of the collection. They were found by Soviet explorers wintering near Cape Cheliuskin last year.

Existence in the Arctic settlements is becoming more livable as the amenities of civilization make their appearance. Each winterer is given a monthly medical examination and special diets are prescribed. As a result, only one serious case of scurvy has developed in the past three years. Hospitals give regular ultra-violet ray treatments as a prophylactic during the long winter night.

A few months ago medical science and radio combined in dramatic fashion to handle successfully a most difficult case of childbirth. The physician on Dickson Island received an urgent message one night from the doctor at far-off Cape Desire, on Novaya Zemlya, requesting advice on a confinement case of a

type on which he had had no previous experience. The former, standing at the microphone, gave detailed instructions. Within three hours a radio message of gratitude was received from the happy father. The news spread throughout the Arctic stations and the doctors, radio operators and the mother were showered with messages of congratulations.

Last summer, the Polar Theatre, a troupe of fourteen entertainers, in a tour lasting four and a half months, gave sixty-nine performances. Their itinerary included the decks of vessels in the Kara Sea and at the mouth of the Lena River. Programs ranged from vaudeville to Molière's *Tartuffe*. Costumes and sets were carried in large cases which could be converted into a stage. Some of the performances were given for lumberjacks, hunters and other workers at midnight, without the use of artificial light.

Morale

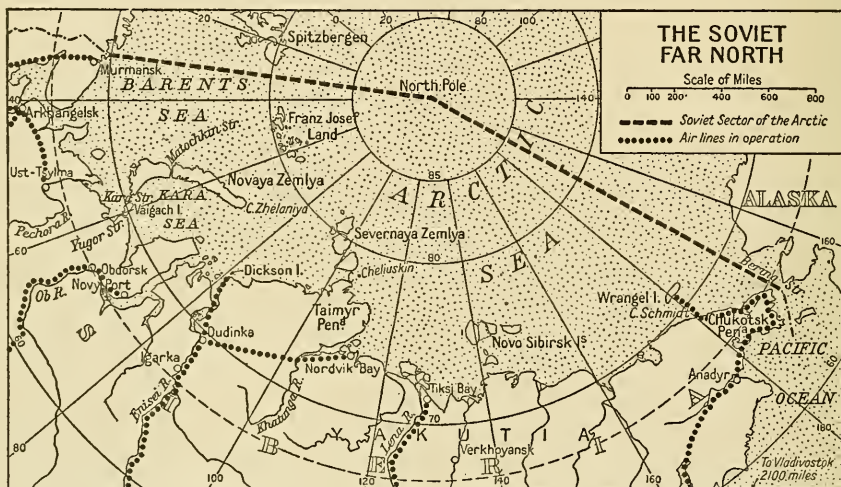
The varied diversions, the spirit of comradeship, and the never-ceasing activity have done away with the dreaded melancholy, once considered an inevitable concomitant of life during the Arctic night. Svetakov, chief of the winter settlement on Dickson Island in 1934-35, in describing how the gloom and terror invariably suggested by the long polar night were dispelled, said: "Our men experienced no emotional pangs. Scientific and social activity absorbed all our energy. If one commenced to brood or pine, the entire group

would endeavor to surround him with attention and care until the mood dissolved. There was little time for loneliness."

Maxim Gorky, in a recent broadcast to 2000 young people who had sent him a collective letter from the Arctic city of Igarka, said: "In the darkness of the polar night the sun of human intellect shines brilliantly." And its light has brought new life to the indigenous peoples of the far North. Doomed to slow extinction from exploitation, vodka and disease, the principal contributions once brought to them by civilization, they have now taken on a new lease of life. Where the population was formerly 100 per cent illiterate, there are now scores of schools, attended by thousands of children. Where the art of healing was the exclusive prerogative of native shamans, there have been established hospitals and medical stations. A few years ago tribes were discovered in the taiga so primitive that they did not know the principle of the wheel. Now the various northern nationalities send their promising young people to study at the Institute of Peoples of the North in Leningrad.

The Arctic yields

In ten years a wilderness inhabited by primitive tribes has been explored and made useful. Where only a few explorers previously ventured, a wave of civilizing influences has created the habitable and productive white continent of the Soviets.



Courtesy of "Foreign Affairs"

The U.S.S.R. in the Arctic

(Below) A pioneer in Arctic commerce: the steamer "Anadyr," one of the four freight ships which in 1935 linked the Atlantic and Pacific Oceans by voyages across the Arctic. All four

ships carried large cargoes of supplies for the extreme North. The voyages culminated years of struggle to open up the Northeast Passage for commercial navigation



All Photos by Sovfoto

Four powerful ice-breakers were stationed in the most difficult sections to convoy the freighters through heavy ice. The vessel at the extreme right is the famous ice-breaker "Krassin"; next to her is the steamer "Tovarish Stalin," on board which is the Lena-Khatang expedition, whose mission was to found a settlement at the mouth of the Lena





Provisioning the "Sibiryakov" for her memorable voyage in 1932: taking on bullocks which provided meat during the first Northeast Passage to be made in a single navigation season

On board the "Sibiryakov." Professor Schmidt, commander of the expedition, Captain Voronin, Professor Wiese, and T. Azaev discussing plans. After numerous difficulties the "Sibiryakov" reached open water in Bering Sea on October 1





Radio plays a big part in the Soviet program in the Arctic. The above is a picture of the station at the mouth of the Lena River, at 72 degrees north latitude. The operators maintain contact with the nearest cities and with other parties and expeditions wintering in the Arctic, greatly increasing the safety of their exploratory activities



A scene along the route of the "Sibiryakov's" 1932 voyage: crews going ahead to dynamite unyielding masses of ice



Tapping the resources of the Arctic: a Soviet trawler hauling his net on board. The fish catch in the Arctic has increased from less than 1000 tons in 1932 to over 5000 tons last year. Canneries operating in the north turn out about 2,500,000 cans a year

A catch of seals on the ice-breaker "Sibiryakov." These are the skins, the fat having been removed and placed in special containers. One of the forty-nine special expeditions planned for 1936 will study the White Sea herds of Greenland seals



(Right) Exploiting the rich apatite deposits on the Kola Peninsula, which have made the U.S.S.R. an important supplier of phosphate fertilizer. Where a few years ago only a few nomadic Laplanders roamed the snowy wastes, there has grown up the important industrial center of Kirovsk, with 40,000 inhabitants.



(Above) An unusual application of serotherapy: a veterinary inoculating an ill reindeer



The first wooden house built at the strategic settlement of Ust-Lena ("Mouth of the Lena"): a bakeshop constructed of driftwood



Meteorological work being carried on aboard the ice-breaker "Krassin" in the Kara Sea. A so-called radio-probe recently invented by Professor Molchanov facilitates study of the stratosphere by automatically transmitting the readings from instruments that are sent up in small balloons





(Above) A scene in a dwelling house in the new settlement at the mouth of the Lena

(Below) A hasty unloading at Tixie Bay, at the mouth of the Lena River. As soon as the Lena-Khatang expedition disembarked, the steamers hurried back to Archangel





(Above) A result of recent scientific exploration: a four-year-old city of 40,000 inhabitants, Kirovsk, north of the Arctic Circle on the Kola Peninsula. The discovery of rich apatite deposits gave rise to this city. New apartment houses are replacing the wooden houses shown in this picture. The 60,000-kilowatt hydro-electric station on the

Niva River is the most northerly in the world

(Below) The talking cinema theater at Kirovsk: a reinforced concrete building accommodating an audience of 1200. The city also has hospitals, modern schools and clubs, and is becoming a popular tourist resort for Russians



8000 Miles of Northern Wilderness

An exciting expedition to the Barren Lands, the Arctic coast, and up the swift Nahanni River, which brought back new knowledge of the great animals of the Northwest

By GEORGE G. GOODWIN

Assistant Curator of Mammals

From the diary of

HARRY SNYDER

THE Harry Snyder 1935 Barren Lands Expedition covered considerably more territory and took us much farther north than the Snyder-Canadian Expedition of the previous year. Like the latter trip it was made possible through the generosity of Mr. Harry Snyder; and much of this narrative is derived from his diary. He not only carefully planned but also led the expedition over 8000 miles of northern wilderness.

Although the first objective of this expedition lay in a region which Mr. Snyder and I have already described in a recent issue of *NATURAL HISTORY*¹, namely wood buffalo country, an experience which occurred there deserves to be mentioned in brief.

Mr. Snyder was to meet me later at the Slave River when I left Cooking Lake, Edmonton, on July 17, 1935, in a Fokker monoplane. Dense threatening clouds, pelting rain, and flashes of lightning with deafening peals of thunder marked our exit from the civilized world.

Flying in a storm has its own thrills. The wind whistled as the plane, straining at the struts, labored northward over the billowing clouds. I was later to learn that the storm beneath us washed out many miles of railroad, flooded considerable territory, and demolished many villages.

First stop

At 4:00 p.m. we landed at Pine Lake. The following day, accompanied by Mike Dempsey, the head forest ranger, I trailed through the forest north of Pine Lake with the purpose of getting motion pictures of the wood buffalo.

Rain fell steadily all day, until about 7:00 p.m., when I located a herd of buffalo in a grove of jack pine and spruce trees. The next morning I left camp at 2:00 a.m., intent on stealing among the buffalo under cover of darkness. Before daybreak I was safely settled in a blind. Occasional grunts from several directions indicated that luck was with me; the animals had not moved away. The long wait until sun-up was a trying period, for mosquitoes swarmed in countless numbers.

I got the first pictures about 7 o'clock. The herd of about thirty animals, mostly bulls, milled restlessly around my hiding place. The hum of the movie camera did not seem to disturb them and through the branches I got some excellent shots; but the first click of my Graflex caused a general drifting away. As the morning advanced their distrust increased, and by 10 o'clock the last of them had disappeared.

Action

I waited until the third day before they returned. This time I was in for some excitement. The herd milled around, rolling in the wallow and rubbing on the trees to rid themselves of insect pests. I patiently waited to photograph a certain big bull. Slipping from tree to tree I approached him cautiously. At the first whirl of my camera at close range he wheeled about, faced me and stood motionless. Placing myself against a tree to steady my palpitating heart and shaking knees I continued to run off film. Then suddenly, from directly behind me, came a burst of compressed air, like the escaping steam of a locomotive, warning me of unsuspected danger. I turned my head very slowly and saw, to my amazement, a curly head and massive horns smeared with blood. A gigantic bull was not more than twenty-five feet away.

The silence that followed was intense. The

¹ "Buffalo Hunt—1935," by Harry Snyder and George G. Goodwin, *NATURAL HISTORY*, September, 1935.

bull was holding his breath and I remember distinctly that his big dark eyes appeared to be of a deep royal purple. No white showed at the corners, marking him for a genuine wood buffalo. His shoulders scraped the branch of a tree, which later proved to be seven feet from the ground. After a seemingly endless wait he emptied his lungs with a sudden spurt and charged. His huge form lunged forward at an amazing speed. I actually felt a rush of hot air as he hurled himself past me at the other bull. Then, to my relief, both animals passed into the timber and out of sight. Apparently he disdained to bother with anything so insignificant as a mere man when an opponent more worthy of his stupendous strength was at hand.

I had secured a thousand feet of buffalo pictures in the timber and many still photographs. On the salt plains and on the way back to camp I photographed some other animals, including a solitary old bull at twenty feet and a splendid specimen swimming across Pine Lake, with his tail arched clear of the water and his snout, horns, and shoulders just above the surface.

We had to hurry to meet Mr. Snyder at the Slave River. We had thirty-six hours in which to cover a distance of forty miles of forest and swampy muskeg. Breaking camp at six in the morning we found the black flies, bull-dog flies and mosquitoes more annoying as we approached the lower country. We arrived at the Slave River as the sun came up the following day, having halted only once to water and feed the horses. Then we learned that our forced march had been unnecessary. Mr. Snyder did not arrive until evening. He and his pilot, Stan Mac-Millan, had been forced down twice by storms in their giant Bellanca, and had passed the night at Lac la Biche. Accompanying Mr. Snyder were Col. Steel, government representative, and Jim Ross, outfitter, from Hudson Hope.

To study musk oxen

Our main objective in the Barren Grounds was to secure pictures and make a survey of the musk oxen in the Sanctuary, together with proper recommendations as to the present and future boundaries of the Sanctuary. Leaving a storm behind us we flew eastward over the many islands and intricate bays of Great Slave Lake and landed at Snowdrift where our

guide, a Chippeweyan Indian, was to meet us. He was not there. We learned that he and his family were encamped at Lost Channel some seventy miles away. So we flew over there and anchored in the bay. The guide made a spectacular picture standing in the bow of his galley while his eight braves, with long swinging strokes of their paddles, brought him out. After an extensive argument we persuaded him to come with us.

Into the barren grounds

From Fort Reliance, where an ample supply of gas had been shipped in by boat the year before, we followed the Lockhart River and the north shore of Artillery Lake, Ptarmigan Lake, and Caribou Narrows to the great waters of Clinton Colden. As our plane landed in a sheltered cove, two bull caribou left the rocky beach for the mossy hillside and stood silhouetted against the sky. Here we had the most comfortable and pleasant camp of the entire trip. The air was clear and crisp, and no insect pests bothered us.

Our guide, big chief of his clan, proved to be an interesting character. His name, Catholique, has no religious significance but means "rabbit blood." He showed unusual ability in recognizing land marks from the air. When Stan delivered him back to his own village he stated, "I go into flying canoe; I help load with gas, grub, and tents. We fly over the mountains; we fly over lakes; I help carry gas, grub, and tents out of flying canoe—still I don't believe it."

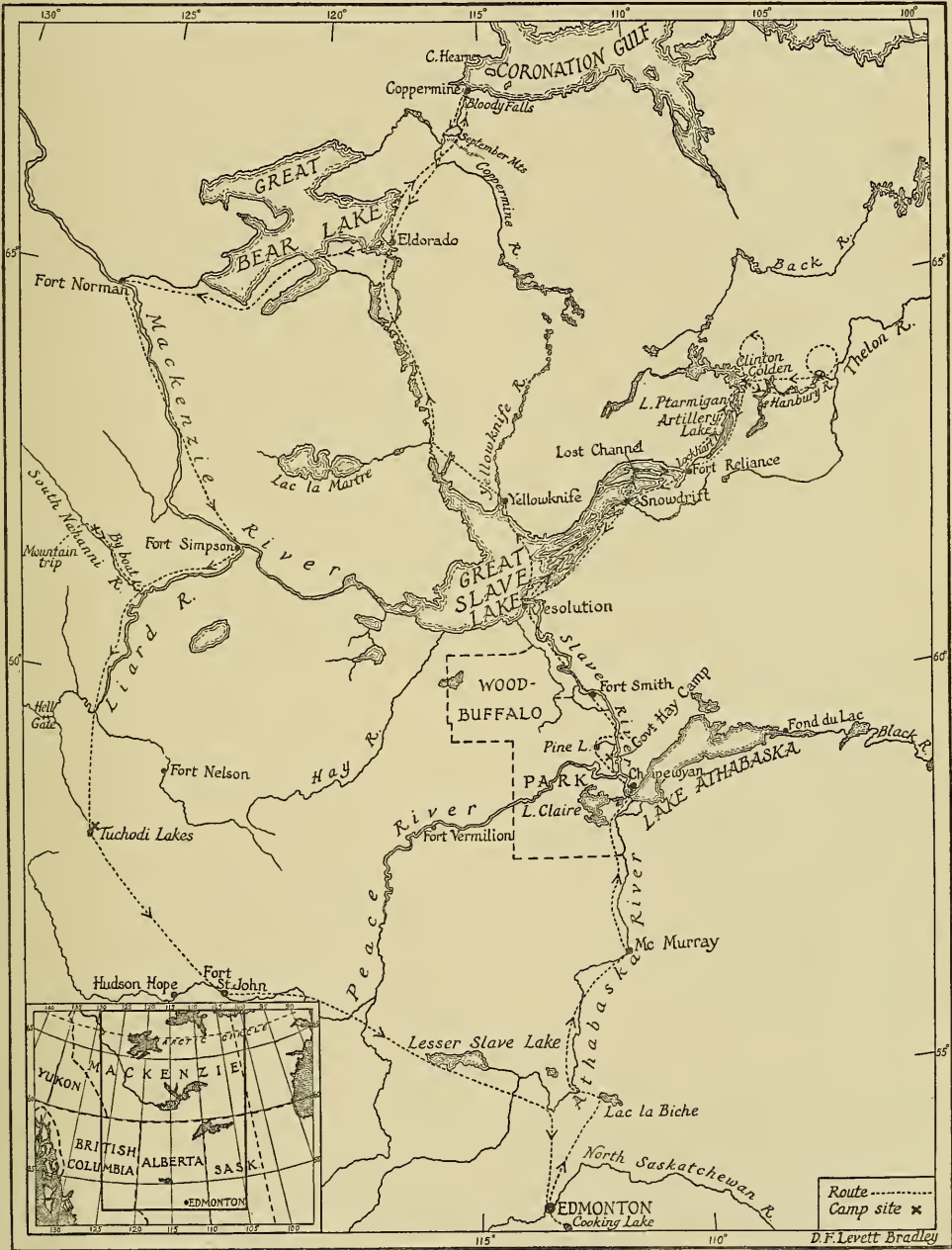
We scouted from the air for signs of musk oxen. Flying over the area north and east of Clinton Colden towards the Black River we were amazed at the extent of bare granite landscape. A few miles south of this area, along the northern boundary of the Thelon Game Sanctuary, the ground was covered with lichens and the edges of some of the lakes with small willows. Not sighting any musk oxen here we continued eastward past Sifton Lake.

It was on the banks of the Hanbury River, near its confluence with the Thelon, that we saw the first musk oxen, a band of about twenty. We could not land in this vicinity, but a small lake farther on proved suitable and we descended to an excellent shelter in a cove surrounded by steep banks.

After the failure of a laborious attempt to

approach a second group of animals that we had also sighted from the air, and traveling on foot distances which seemed many times longer than they had from the sky, we spied, later in the day, a lone bull musk ox on a narrow neck of land between two lakes. By crossing two swamps infested with black flies

and fording a river which we never suspected was there, we approached under cover to within 150 feet of the animal. He was lying with his back towards us. Our guide skirted the lake and came out twenty-five feet from him. The creature jumped up, raked the sand with its horns and charged. The Indian, a few



The Route of the Harry Snyder 1935 Barren Lands Expedition

feet ahead of him, leaped over the bank and went headlong down to the lake.

The bull, now fully roused, frequently rubbed his nose on the glands inside his fore legs. I approached cautiously to get some close-up pictures, followed by Colonel Steel with a rifle at his shoulder. The bull made several short rushes toward us but could not quite make up his mind to come all the way. When we were getting so near that retreat would not be possible I asked if he was quite ready with the rifle. He replied, "How the blazes do you take the safety catch off?" It did not take me long to get away to a safe distance.

Back at camp the mosquitoes and black flies were very thick. Realizing the hopelessness of trying to locate animals on foot, we piled into the plane and scouted along the Thelon River and surrounding lakes. Just east of Grassy Island we located a large herd of musk oxen, bulls, cows, and calves. And on the way to the nearest lake we saw another fair-sized herd in a grove. But when we taxied across and landed, the latter herd had completely disappeared. There were no flies, so we did not mind the long trek back to the first band. The musk oxen were still feeding by the lake, and we were able to approach reasonably close. But the dense growth of willows and the necessity of sighting into the sun made photographing difficult.

One old bull musk ox waded out into the lake and swam across. As his heavy coat of long hair gradually became saturated with water, he sank lower and lower. When he approached the opposite shore only his nose and the crown of his head remained exposed. The rest of the herd, sighting us, gathered in a defensive ring formation—this is called "defense carrière"—and then stampeded past us and over the top of the hill. Another herd about three miles away caught our scent and dashed off after the first one.

Plane endangered

Trailing over the last ridge on our return trip, we were amazed to see that both herds had congregated on the beach by the plane. What disturbed us was that the plane, our only communication with the outside world, seemed to be in danger from their rampages, and they could get away without retreating some dis-

tance towards us. We hurriedly closed in on them. They galloped back and forth and, finding themselves cornered, plunged into the lake and swam across. One old bull got so waterlogged that he barely made the opposite shore. Two others preferred to take the long trek around the lake.

From our observations, I am inclined to believe that the musk ox is as strong and rapid a swimmer as the buffalo. We counted a total of 171 animals in one tenth of the musk oxen range and concluded that there are approximately eight hundred musk oxen in the entire Sanctuary. Well satisfied with the day's pictures we circled wide towards the north on our flight back to camp. Smoke seen in the distance was explained by Catholique as a signal sent by the Eskimos, but flying directly over it we could see no one. The fire had burned over quite an area but was dying out. Smoke that was seen the previous day had been answered by Catholique, when he and Jim were on the ridge back of our camp. They were definitely answered in smoke signal language, which conclusively proved at that time the presence of the Eskimos.

Back at Clinton Colden the next day our base camp was a welcome sight. Plenty of supplies; and the greatest boon of all, we were free from the host of insect pests.

Treacherous weather

The following day I was to get photographs of the caribou on the shore of Clinton Colden, while Mr. Snyder was to take the plane and scout along the north shore. The morning broke clear and the lake was like a big sheet of glass. We saw three large lake trout tearing chunks from the meat we had put in the lake to keep fresh. Everything looked favorable for a good day. Mr. Snyder called attention to the falling barometer, the pilot climbed a nearby hill for a lookout, and came down in a hurry saying that we had to leave within twenty minutes. In ten minutes the barometer dropped ten points. Suddenly the wind sprang up and before we had half loaded the plane the sun was blotted out by threatening banks of clouds bearing down from the east. A considerable swell rose on the lake, and when we took off we bumped along the tops of the waves before finally rising.

Visibility became poor as the storm closed in on all sides. Tracing the outline of Artillery Lake we raced at less than a thousand feet expecting every minute to make a forced landing. But beyond Lockhart River the weather cleared and we alighted at Fort Reliance beneath a cloudless sky. The following day, however, bad weather again beset us, and the necessity of landing at Resolution on the breakers of Great Slave Lake made a serious problem. After bounding from wave to wave, however, our pilot skillfully eased us into calmer water behind the breakwater. That night the storm increased. Part of the dock was washed away, boats broke their cables, and, to our dismay, the next morning the plane was gone. Both anchor cables had parted. We saw its green and gold outline upon the beach across the bay. Fortunately, the French Padre at the Mission woke us up at daylight and Harry, Stan, and Jim got over to the bay before the plane drifted in and were able to anchor it before any serious damage was done. That storm delayed us three days. It was here at Resolution that Dorothy Snyder and Sam Sackett joined us.

To the Arctic coast

On our trip to Coronation Gulf on the Arctic shore for pictures we followed the course of the Yellowknife River to Great Bear Lake where we spent a week as the guests of Mr. Gilbert LaBine of the great radium mine known as Eldorado. From there we flew across the eastern end of Great Bear Lake, over the September Mountains to the Coppermine River and on to Coronation Gulf. On the road we dodged five snow squalls. A most interesting day was passed at Fort Hearne where Mr. Snyder secured a specimen of Barren Land grizzly killed by the Eskimos last spring at Bloody Falls on the Coppermine. Our next objective was the Nahanni River country, where we hoped to secure specimens of white sheep with black tails.

The Nahanni River flows southeastward through wild country into the Liard which joins the MacKenzie. It is a most beautiful, but extremely turbulent mountain river, with an average fall of eight feet to the mile. In places its current reaches fifteen miles an hour. The average width of the river is about two hundred yards, and its valley is for the most

part narrow and passes through a tremendously rugged chain of mountains. In places the valley widens out and shows considerable forested alluvial land. The landscape is a jumble of rough mountains, irregular steep ridges, hills, valleys and ravines.

On arriving at the mouth of the Nahanni we learned that the boat, which had been constructed last year for the express purpose of making this trip, had been wrecked on a trial run. It was a 40-foot craft, carrying two 50-horsepower engines. A snag had been driven clear through the bottom and deck of the boat. Thus the swift Nahanni retains its evil reputation. We had to rent two 28-foot pointer scows from local trappers and prospectors and search for outboard motors downstream as far as Fort Simpson and up and down the Liard. Finally we secured them and started up the Nahanni.

The 140-mile river trip was most interesting. The first fourteen miles above the junction with the Liard was pleasant, the river being wide and deep with only a four-mile current. At dusk we encountered a bad riffle. Mr. Snyder's boat got over all right; but when mine was nearly through it broke a drive pin and we shot back half a mile before we could regain control.

Snags

We had not gone far the second day when we had to line the boats along the shore. Then we arrived at the first "splits." These places, where the river divides into many channels, are characterized by extremely rapid and shallow water. Hundreds of snags and sweepers always harass the traveler just above and below the steepest parts of these rapids. In some places the snags pointed upstream, an entirely new experience to us. Travel was dangerous and most arduous. In some places the water was so swift that lining again had to be resorted to. The "splits" continued for forty miles.

The river wound back and forth across a wide valley, between rugged mountains, and finally carried us toward an isolated group known locally as the Buffalo Mountains. These mountains derive their name from the fact that a small vagrant band of from twenty to thirty buffaloes dwell there, probably having strayed from the Sanctuary.

Just above the Buffalo Mountains we reached the first canyon and the so-called "tropical valley," which in reality is a series of five hot sulphur springs just under the escarpment of the first canyon. This first canyon is a spectacle of indescribable beauty and grandeur.

There were many signs of game, but we were after a particular animal; and from two local prospectors whom we met just below the first canyon, we gleaned an encouraging piece of evidence. The prospectors, George Buda and Joe Clark, from Muncho Lake, B. C., had been up the Flat River and were bringing out some coarse gold. What caught our eye was the pelt of a sheep which they had secured in the canyon. Its well defined black-tipped tail aroused our hopes to a high degree.

Fire

Our navigation problems continued. The gas tank on Harry's boat leaked continually and eventually caught fire. He had thirty gallons of gasoline in his boat, certainly not a comfortable situation in a very rapid river. Near the top of one especially swift riffle between high cliffs, our boat broke a drive pin and we headed straight for a smash against the cliff. Our paddles were shattered when we tried to break the impact against the cliff and the guide's pole shot out of his hands and drifted away. Then with a thud we hit a partially submerged rock and were wedged in with the water pouring over the side. It seemed that at any moment the boat must be sucked under. But she swung around presently and grated along the side of the cliff. Then we headed straight toward a rock in midstream. We hit it, but fortunately broke clear and slipped downstream still afloat. The Indians took the whole incident as a matter of course, but I still believe that we just escaped by the skin of our teeth.

The going continued to be rough right on to Deadman's Valley, which is so named because of the many lives that have been lost there. To us it brought a welcome relief because we could jog along with relative ease. The Gates came as a complete surprise, sheer walls rising 2500 feet on one side and 1500 feet on the other from the water's edge, where the river appears to have cut its channel right through a mountain. Base camp was just beyond the

Gates. Two Indians whom we had sent ahead to establish camp assured us that they had seen quite a number of sheep ten miles beyond.

The following day we proceeded to the mouth of Mary River and then inland some six miles on foot, carrying our equipment on pack dogs. Some 3500 to 5000 feet above the river we found the sheep, in the Alpine meadows and on the shale ridges. With Dorothy Snyder on one side of me and Mr. Snyder on the other we came suddenly into full view of the specimens we so much desired, only two hundred yards away. I was able to get some pictures before the animals started to move. Dorothy brought down a big ram to the left and Harry shot another large one on the right. Dorothy, who had started out with only three shells in her rifle, picked out the next two large rams and without missing a shot completed our group of white sheep. The animals were in excellent condition and had, in greater or lesser degree, black tails.

A cold wind brought a chilly rain, and leaving our specimens temporarily we had to retrace our steps for two hours to where we could find timber to stretch a fly and make shelter for the night. Supper that night consisted of roast sheep, which tasted good; but none of us slept much in the cold.

The next morning Jim Ross and I returned to complete the preparation of the specimens. The task of carrying back the heads and hides was extremely arduous, and the distance which we had expected to cover in two hours took us all day. We were all glad to get back to our base camp at the Gates.

The return in the boats to the forks of the Nahanni and Liard was comparatively easy; whereas we had taken five days in the ascent, we shot back down in half a day. The gas tank of our motor still leaked, and with the last spurt of the motor we just made camp.

A mountain paradise

The next day about noon we took off for northern British Columbia to search for stone sheep and the new found elk which Mr. Snyder had located the previous year in this area. At Nelson Forks, clouds hanging over the mountain peaks halted us for a day. Then climbing to about 7000 feet we crossed the range and dropped down to the Tuchodi

Lakes. Tuchodi in Slave Indian means "rough waters." These lakes occupy a beautiful valley extending in a narrow curve for about thirty miles. They range from half a mile to a mile in width and from about seven to ten miles in length. With the exception of the second lake the waters are deep blue and are very deep, but the upper third of the second lake is discolored by glacial silt. The rugged scenery compares favorably with that of Jasper Park or Lake Louise.

A pack outfit met us here, having come 460 miles from Hudson Hope. It was in the high alpine basins or eight miles back from the lake that we pursued our search for stone sheep. After seeing a few animals here and there and getting some good pictures of them we were amazed upon peering over the ridge to see forty-one rams on a ledge at the foot of a high cliff. With the exception of one or two saddlebacks they were all dark blue stone sheep. Three rams were selected for specimens. Dorothy brought one down with a single shot, a splendid example with wide, spreading horns. Mr. Snyder and Mr. Sackett got the other two, both beautiful sheep with massive heads. These alpine basins offer ample conditions for stone sheep, with splendid feed and cover. We saw no signs of wolves here, and there were apparently few bear.

After a day in camp we started across the mountains for the Prairie River country in quest of elk where we had seen them last year. Though the elk were more wary than we had anticipated, indicating that they had been frequently shot at in spite of the restrictions, we were able to make a fair selection and secure our series.

Joe, one of our Indian guides, felt much put out when he had to spend a whole day with me simply getting pictures. Without a gun, the day was apparently spoiled for him; but I secured some excellent pictures of caribou near a salt lake.

Mysterious theft

Back at the camp at Tuchodi Lakes we were mystified by the disappearance of our cache of sheep meat, which had been strung on a rope between two trees some fifteen feet from the ground and covered with a tarpaulin. The rope was broken, all the meat was gone, and the

tarpaulin showed claw holes. Our Indians could make nothing of it. Both trees were innocent of any claw marks and to add to the mystery a pile of meat scraps on the ground nearby had not been touched.

Then about 2:00 a.m. the following night I was aroused by the snapping of a branch a few feet back of my tent, and hurrying outside made out the figure of a bear moving between the trees. The Indian advised me against shooting at such close range in the dark. The following day the mystery of the disappearing meat was completely solved. A black bear ambled up to inspect our camp and betrayed his guilt by looking up to see if there were any more hams hanging between the two trees.

While some of us remained in camp to prepare our trophies, Dorothy was in the mountains above the second of the Tuchodi Lakes photographing stone sheep and Rocky Mountain goat on the same hillside only a hundred or so yards apart.

Elk, caribou, moose, and stone sheep find a natural home about the headwaters of the Prairie and Henry Rivers, and in the region of the Tuchodi Lakes. The sheep are extremely numerous, and have ample feed. There are a few goats in the same area, some caribou, moose and grizzly. Three grizzlies were observed but none procured.

A quick get-away

When the planes for our return trip were two days overdue, delayed by clouds enveloping the mountain peaks surrounding the lake, a clear day brought them swooping down to our camp. We were so anxious to get out before the clouds closed in again, that we loaded up the two Fairchilds and were on our way within an hour. The heavily loaded planes labored over one-half the length of the lake before they could rise. Skimming then over the tree tops we climbed out of the narrow valley in three or four circles. Beyond the high mountain peaks we headed for Fort St. John, and from there followed the Peace River and the shores of Lesser Slave Lake, back to Edmonton.

Our program had covered a vast territory and many objectives, and it was due entirely to Mr. Snyder's keen interest and unfailing persistence in spite of frequent set-backs that each project was carried through successfully.

8000 Miles of Northern Wilderness



Pine Lake, in the Canadian Wood Buffalo Park: the first objective of the Harry Snyder 1935 Barren Lands Expedition, which had for its purpose a study of the great animals of the Canadian subarctic



A photograph of a small and diminishing race of animals: wood buffalo in the sanctuary which has been established for their protection



(Above) Glimpses of unsuspecting wood buffalo in the jack pine and spruce forest of their range. At this season the buffalo rub against

the trees to rid themselves of insect pests (Below) An old grandfather of the herd: a formidable subject for the animal photographer





Flying northeastward over Great Slave Lake: a photograph from the plane en-route to the country of the musk oxen



Mr. Snyder, the leader of the expedition, with members of the party and local settlers



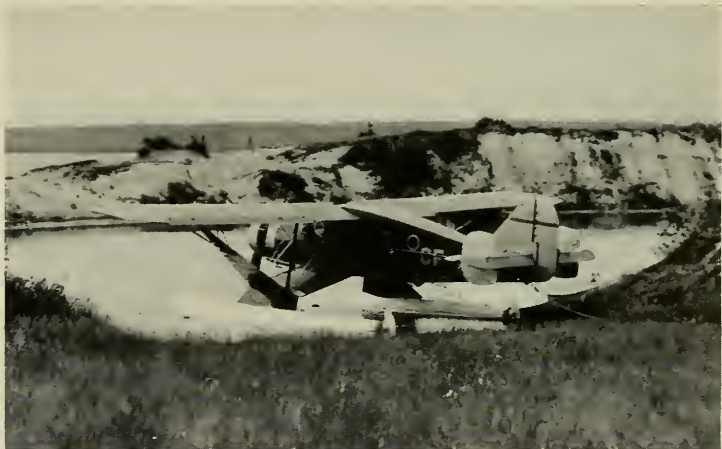
(Left) Looking west from the eastern end of Great Slave Lake

*A solitary old bull musk
ox in the Thelon Game
Sanctuary*



*(Above) On the border of
musk ox country: the expe-
dition's camp and plane at
Clinton Golden*

*(Right) A landing near the
confluence of the Hanbury
and Thelon Rivers, where
the party sighted their first
musk oxen from the air*



(Right) The wild Nahanni, a beautiful but turbulent mountain river which the expedition ascended in quest of a variety of white sheep with black tails



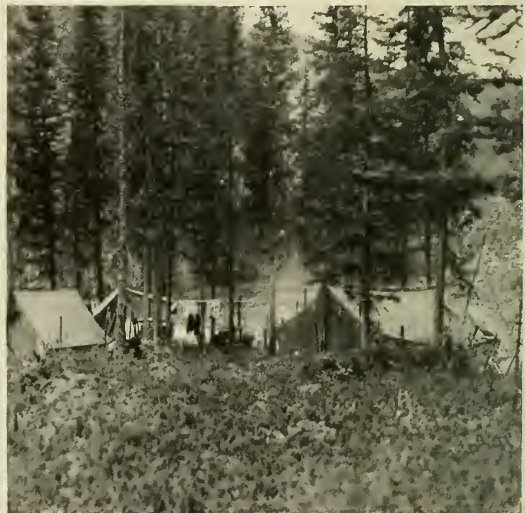
(Below) Pack dogs used by the expedition contentedly riding the swift water of the Nahanni



(Below) On the banks of the Nahanni River, with a specimen of black bear just secured



(Below) Camp at the Gates of the Nahanni in a forested valley





(Left) The scenic Gates of the Nahanni, sheer walls rising to great heights from the water's edge, where the river appears to have cut its channel right through a mountain



(Below) The boat designed for the trip was wrecked on a trial run, and two 28-foot scows of the type shown here were used

(Below) Tuchodi Lake, in northern British Columbia, a region of rugged beauty



(Below) Preparing the stone sheep trophies and smoking the meat





A denizen of the alpine meadows of northern British Columbia: a yearling ram stone sheep



(Above) Harry Snyder, leader of the expedition, and Dorothy Snyder, his daughter, who brought down some of the finest trophies

(Right) The expedition in elk country: along the Henry River, British Columbia



INDIAN TYPES

by

Maaron Glemby



*"Dancing Boy," son of famous
dancer "Turtle." A Black Foot
Indian*



CHARLES
E. M. 1907

*"Short Face," of the
Black Foot Reservation,
Montana*

*"Weasel Tail," a Blood
Indian warrior of Al-
berta, Canada, in his late
seventies*





*"Bird Rattle," of Blood Indian
Reservation, Alberta, Canada*



"Body," another Blood Indian

*"White Man," a Blood Indian
wearing a necklace of deer or
antelope ankle bones*



*"Tall Man," of Blood Indian
Reservation, Alberta, Canada*





"Laura Buffalo-Boy," Sioux Indian girl of Standing Rock Reservation, North Dakota

"Agnes No-Heart," Sioux girl, wearing shell garment handed down for several generations



"AGNES NO-HEART"



*"Mary Yellow Lodge,"
Sioux Indian girl, wearing
neckpiece of beads and bones
of waterfowl*



*"Mrs. Percy Creighton," of
Blood Indian Reservation,
Alberta, Canada*

How Insects Protect Their Eggs

Strange ways in which insects provide for the care and feeding of offspring they will never see

By C. H. CURRAN

*Associate Curator, Department
of Entomology*

THROUGHOUT all the stages of their existence insects are particularly subject to attack by enemies, and relatively few of them survive to a ripe old age. In order that they may survive they have undergone many modifications in habits and structure and some of them have developed what are undoubtedly the most marvelous adaptations to be found anywhere in the animal kingdom.

No end of marvels

The discovery of some unusual trait in any of the vertebrate animals almost invariably results in much discussion and expression of amazement—but not so with the insects. The whole insect kingdom is so filled with startling and inexplicable habits that the entomologist no longer is amazed but accepts new discoveries in a most casual way, even though the newly observed practice may be so astounding as to be scarcely believable.

The dangers to which an insect egg is exposed from the moment it is laid include not only animal and plant enemies, but also frost, heat, moisture, dryness. When all the manifold hazards are considered we must marvel that these creatures are able to survive.

There are many things about the ways of insects that we do not understand. It has been customary in place of complete explanations to refer their remarkable habits to instinct. While this may be the only word that can be applied, it does not tell us how these habits originated. Few if any insects show any evidence of reasoning, yet there is undoubtedly reason behind the development of many of the things that they do, and man has never equalled them in some of their accomplishments.

As an example we might consider one of the ichneumon flies that is parasitic on the European corn borer, a pest that has become very common in the United States since its introduction a dozen years ago. The ichneumons are classed with the bees, ants and wasps but are very different in both habits and appearance. They are almost all long, slender insects, and the female is provided with an ovipositor that varies in length according to the habits of the adult in laying eggs. The ovipositor is composed of three rigid, hair-like appendages which are used for drilling and which form a tube through which the egg passes. The particular species that is parasitic on the corn borer is able to determine the location of the borer within the corn stalk, insert its ovipositor into the caterpillar and lay an egg. Man, up to now, has not devised a method by which the larva can be located. It is all the more remarkable in view of the fact that insects are not considered to be intelligent creatures. We know that these ichneumons do this but we do not know why, nor how the practice developed.

Eggs are hidden

Concealment is the most generally practised of all methods of protecting not only eggs, but also the young of animals. Almost all land animals conceal their young and primitive man was no exception. Just as the tiger, the deer, the birds and other creatures seek a hiding place in which to harbor the young until they are able to fend for themselves, so do insects hide their eggs. There is a difference, of course, because the larger land animals are able to protect their young while most of the insects cease to have interest in their offspring as soon as the eggs are laid. This does not apply to social insects, that actually feed the young and care for them, if not with tenderness at

least with a devotion to duty that might well shame some of us intelligent moderns.

The method of concealing eggs may be of a most primitive nature, consisting merely of placing the eggs in some crevice in bark or under leaves, or it may be extremely complicated. Many insects lay their eggs within leaves or under the epidermis of the stems of leaves or green twigs. Most of the saw flies are equipped with a saw-like ovipositor with which they are able to cut the surface of a leaf and insert an egg beneath the epidermis. The young of these are leaf miners, living within the leaf until they are ready to pupate. Many other insects deposit their eggs in the twigs of plants and thus secure excellent protection for them.

Protection against other insects

The advantage in such a method is the defense against other insects that might parasitize the eggs; and thousands of different kinds of insects have developed it. The young of very many of the insects that lay eggs in twigs, upon hatching out, feed outside the wood.

Still more protection is secured when the eggs are deposited well beneath the bark, particularly if the young feed in such places. The horntail, an insect injurious to trees, lays its eggs in the solid wood, having an ovipositor that enables it to pierce the bark. The act of oviposition by this insect is not always without danger to the mother. It often happens that she is unable to withdraw the ovipositor with the result that she dies, her carcass hanging rigidly on the side of a tree to attract the attention of passers-by. Whether these dead horntails are martyrs to an overzealous desire to deposit their eggs deeply or not is a question that is open to some doubt. It is altogether possible that they have already laid many eggs and that death resulted from natural causes due to the wearing out of the organism.

The habit of protecting the egg by injuring the plant on which it is laid in order to prevent the growing plant from crushing the egg is not uncommon. A good many of the long-horn beetles that oviposit in wood make an incomplete circle or arc a short distance from the egg, thus preventing growth until the hatching period has passed.

The long-horn beetles known as twig gir-

dlers lay their eggs inside the tender shoots of blackberry and other plants and girdle the twig both above and below the point of oviposition. The girdle is not complete, consisting of a series of round areas that the beetle chews out, but it is quite sufficient to cause the shoot to die above the lower "girdle." When the egg hatches the young larva bores downward into the pith of the living cane, while the dead tip usually breaks off and falls to the ground. In this instance there is a distinct lack of intelligence, because a single "girdle" beneath the egg would be quite sufficient to halt growth. There is a possibility that some of the eggs do not survive either because the lower girdle does not always do its work or the end of the twig breaks off before the egg hatches, leaving the larva no opportunity to bore downward to the healthy cane.

The plum curculio, an insect that feeds and lays eggs in a number of different fruits, but more particularly in apple, peach and plum, always leaves a telltale mark behind. After laying the egg a half circle is eaten out and as the fruit grows this takes on a lunate appearance. This protection is not always sufficient in the rapidly growing fruits and a very large percentage of the eggs die. Anyone familiar with the work of this beetle can always identify the injury and can determine between the feeding and ovipositional punctures.

Most nuts are attacked by some insect. Sometimes it is only the husk that is affected, but some of the weevils attack the kernel. In order to lay its egg on the prospective food supply the mother weevil eats a small hole through the husk and soft shell and inserts one or more eggs into the hole. Since her snout is long and quite slender she is able to bore with little difficulty and without causing more than passing injury to the growing nut. The wound soon heals and only a small spot remains to show that the nut is infested by her offspring.

Jumping beans

The so-called Mexican jumping beans are a familiar sight at places of amusement during the latter half of summer and autumn, always attracting a great deal of attention. They are not beans, but the seeds of certain species of plants belonging to the genus *Croton*, a relative of the castor oil plant. The "beans" them-

selves have no power of jumping, this being furnished by the caterpillar of a small moth which is closely related to the coddling moth which bores into apples. The egg of this moth is laid in the calyx of the young fruit, the young larva boring its way into the pod and attacking the seeds.

The act of jumping results from the activity of the caterpillar within the ripened capsule: it bends downward and takes its tail in its mouth. Then, suddenly straightening itself with considerable force, it causes the "bean" to jump. The larvae of the cheese skippers hop about in the same way, but as they are free living, there is no external covering to be moved by them. It is not positively known why the larvae in the seed capsules jump. It may be for exercise or to move the pod into a position that will prove more comfortable. Heat is often used to increase the activity of the "beans." When it is, the jumping is quite evidently for the purpose of escaping the unwelcome heat.

A first meal of tadpoles

In the preceding paragraphs we have given examples of insects that lay their eggs in or very close to the food that the young will eat. We have dealt with those feeding on plant life or parasitic upon other insects. There are some insects that are parasitic on vertebrates that also lay their eggs directly upon the larval food. Most of the large predacious diving beetles feed upon small fish and tadpoles of certain frogs, and the mother beetle provides for this by laying her eggs in the frothy egg masses of the frogs. When the eggs of both hatch the young larvae of the beetles at once begin to feed upon the tadpoles. As a result the insect larvae secure an excellent start in life and should be in fine condition to carry on their search for individual tadpoles when the egg mass of the frogs is finally depleted of its inhabitants.

The habit of laying eggs within the actual food which the young will eat may be looked upon as a direct protection, since it not only eliminates the necessity of searching for food, but at the same time offers concealment. Some insects are not so considerate of their offspring and the protection sometimes concerns only the species and not the eggs. An example of this is to be found in some Tachinid flies which

scatter more than a thousand tiny black eggs over grassland where caterpillars are likely to come along and swallow them. Inasmuch as these flies are common it is evident that the method is effective even though it may seem to be wasteful.

As to why this habit should have developed we can only guess. Perhaps the adult flies were not sufficiently energetic to search out their prey as most of their relatives do. This, however, is scarcely a good explanation. In any event we may be thankful that this habit serves as an efficient method of retaining the balance of nature. In years when armyworms are abundant, many more of the tachinid eggs are eaten than in a year when caterpillars are less numerous, with the result that probably a uniform percentage of this serious pest is destroyed from year to year. The protection of the eggs in this case is to be found in their small size, as there is very little chance that they will be crushed during the feeding of the caterpillar.

Some of the tangle-veined flies do protect their eggs by laying them in cracks on fence posts or in crevices in the bark of trees, but they have little consideration for the food supply of their larvae because the insects upon which these feed are found in the ground. However, nature has taken care of this situation by providing newly hatched larvae with some long, curved hairs. When the larvae hatch they take a position with these hairs exposed and wait for a gust of wind to come along. When it does arrive they are torn from their seats and carried by the wind, eventually dropping to the ground. Their next task is to find the larva of a June beetle or some other subterranean insect upon which to feed.

Armored eggs

Many insects cover their eggs with a protective substance which may be composed entirely of a special secretion of the insect or it may have attached to it hairs and scales from the mother. One of the better known examples of this type of protection is found in the Chinese preying mantis, an insect introduced into America and now very common in the vicinity of New York. There is no doubt that the covering protects the eggs against some enemies but it also has its disadvantages because it

serves to attract the attention of birds, squirrels and mice. These animals tear open the tough covering and devour the eggs, but they are not the only creatures that attack them for, despite the protection afforded, the larvae of some flies are able to enter the egg mass and develop to maturity. The fly larvae probably receive relatively greater protection than the eggs of the mantis because the apparently empty egg masses will not be disturbed by birds or rodents.

The lowly cockroach

In a group of animals as primitive as the insects we would scarcely expect to find an even greater development of protective covering than demonstrated by the preceding type but it does occur, and, of all places, among the lowly cockroaches. The cockroaches are among the most primitive of living insects, their history dating back at least one hundred million years in geological history. The common and detested cockroach of our kitchen protects its eggs by furnishing a hard egg sac in which the eggs are arranged in rows. When this egg sac is ready to be laid it does not pass completely from the body, a portion remaining within the abdomen of the mother. It is carried by the insect for some days, but before the eggs are ready to hatch it is secreted in some suitable place, the mother taking no further interest in it. Some other cockroaches cover the eggs with only a very thin egg casing and do not carry the case at all.

As to the origin of this remarkable habit we can only speculate. It may have arisen as a result of the inability of the mother to find a suitable place in which to hide the eggs, with the result that succeeding generations carried them for longer and longer periods, or it may have arisen accidentally because of inability to completely discharge the large egg sac.

While we usually think of protection by an exterior covering as embracing only those insects that lay their eggs in masses we know that certain insects cover single eggs. It is also true that we usually consider the protective covering to be a secretion discharged from the abdomen at the time the eggs are laid and we know that practically all eggs are covered with a sticky substance at that time. This sticky substance, which dries very quickly, enables the egg to adhere to the surface upon which it

is deposited and is, of course, essential to the welfare of the egg.

Among the psocids or bark lice the mother protects her eggs in an unusual manner. At least we may consider it unusual, because we know of no other insects that employ the same method. After the egg is deposited the psocid bites off tiny pieces of bark and chews them for a moment. She then ejects onto the egg a drop of saliva in which the masticated bark is contained. This quickly spreads over the egg and dries. The protection offered by this coating is probably twofold—it coats the egg with a substance much darker than the egg itself and at the same time adds a strengthening coating to the thin shell. The food of psocids consists of fungus growths so that the insect has gone outside of its foodstuffs in order to secure a suitable substance.

We are all well aware that bees, wasps and ants build nests in which to lay their eggs and that many of them provision the nests with honey and pollen. These insects not only provide a home and food for the eggs and larvae but many of them actually feed the young and care for them most carefully. However, many of these insects merely provide food, which usually consists of other insects and spiders. The common mud-daubers provision their nests with spiders and lay one egg in each cell. An egg is laid in each cell as soon as it has been stocked with food and the end is then closed to protect the offspring from possible enemies. The enemies of the mud-dauber nest would not have any particular interest in destroying the young larvae, but there are a number of flies that would otherwise welcome the opportunity of depositing living maggots on the spiders. These maggots, having the advantage of being able to feed at once, would devour the food of the mud-dauber larva and leave it to starve to death when it hatched.

A roundabout method

In contradistinction to those insects that protect their eggs by giving them an exterior covering we have others in which the egg shell is very thin in order to allow the larva to escape at the first favorable opportunity. In some of the bot flies this condition exists. The eggs may be laid on the legs of animals, but so long as they remain here they will not hatch.

They are licked off by the animal, hatching almost as soon as they enter the mouth, or at least by the time they reach the stomach. In some of these flies the eggs hatch as soon as they come in contact with the moisture of the animal's nostrils or lips.

Perhaps the most remarkable habit to be found in the insect world has developed in another bot fly that has become known as the "human bot," although it attacks a number of warm blooded animals. This fly actually makes use of other flies to carry its eggs to the host. The carriers most frequently used are mosquitoes but almost any biting fly may be utilized.

The adult bot fly captures a mosquito and deposits a number of eggs upon its under side, sometimes thirty or more, after which it releases the carrier. The mosquito, in search of blood, locates a warm blooded animal and proceeds to feed. As soon as the eggs come in contact with the warm surface of the animal they hatch and the maggots proceed to enter the host. However, they are unable to break the skin but must enter through some wound or a fold where they can exert pressure. The most common point of entry is naturally the puncture made by the mosquito. So this pest not only carries the parasites to their host but actually provides a means for their entrance into it. The same use is made of other biting flies, and in particular of the stable fly, although this latter is less easily captured than the delicate mosquito.

Insect waylayers

There has been published an account of how the adults of the human bot have lain in wait for mosquitoes emerging from pools in order to deposit eggs upon them. When a mosquito emerged it would be observed by the bot adult until it settled. The larger fly would then capture it and proceed to lay its eggs.

If the theory that has been put forward concerning the development of this strange habit is true these egg-layers must have developed their technique to a remarkable degree within a relatively short time. According to one theory the flies originally laid their eggs on the animals themselves, but were limited to those that lived in the forest, because the flies cannot stand the strong sunlight of the American tropics. As a result animals

of the plains were not attacked. However, the flies developed the habit of laying eggs on the leaves of trees overhanging trails which the range animals had made. These leaves would take on some of the odor of the animals and serve as a guide in egg laying. In the same way the mosquitoes and other biting flies are supposed to retain some of the odor after feeding, with the result that the bot fly would be guided in laying its eggs on suitable carriers. It would be a natural step from this to the development of the habit of ovipositing on newly emerged mosquitoes.

These bots do an enormous amount of damage in South America to the hides of range cattle. It is estimated that the actual loss will amount to at least a billion dollars annually if the vast ranges of the continent are ever fully utilized for cattle grazing. At present the damage is placed at a mere ten millions.

A good provider

Some of the wasps show either intelligence or something that closely approaches it. There are many kinds that dig their burrows in the hard ground and provision the nests with caterpillars. After the female wasp has dug the tunnel she comes to the surface and proceeds to plug the hole with soil, packing and smoothing it so that the entrance cannot be distinguished. She then flies away in search of a caterpillar. When she returns with her prey she opens the entrance to the tunnel, drags the caterpillar in, lays an egg on it and once more covers the entrance, this time using greater care than before. Some species employ a small pebble with which to pack the soil placed over the entrance. The reason for this extreme care is obvious if one cares to watch the operation. Several small grayish flies may be observed in the vicinity of the tunnel. They are waiting for the wasp to return with the caterpillar. Their object is to deposit living maggots on the food. The wasp apparently knows this, because, while digging out the opening, she makes many hurried sorties toward the caterpillar in order to shoo the flies away. Once she has it inside she probably feels safe, but it is often while she is dragging it in that the flies drop the maggots onto it. The relationship between the wasp and flies is a most interesting one and while there have been many

observations made it is not fully understood.

In order that eggs may endure the cold of winter they must be protected by a thick shell, one that can expand without breaking, or by some other means. The eggs of the plant lice, and those of some other insects that are laid singly on the twigs of trees, are small and quite hard. During an average winter they are capable of surviving with only a small mortality and in a warm winter almost all will hatch in the spring. But during a season such as we have just endured the mortality is very high because the contents of the eggs freeze to a greater extent than usual and the vital elements are destroyed. In other instances the eggs themselves become cracked.

The susceptibility to frost and low temperatures is a relative one. Eggs of the same species of aphid occurring in cold parts of Canada and in our South Atlantic States will show a remarkable difference in resistance. Those in the north will withstand temperatures of below zero while those in the south will succumb with only a few degrees of frost. It is not only the cold that enters into this destruction. It is well known that a period of warm and cold spells alternating is much more destructive to insect life than continued cold, because of the relatively sudden changes that take place in the egg. Many insect eggs must have exactly the right amount of moisture and any appreciable deviation from the normal results in death. Some are, of course, laid in water and others in dry sand but these are especially adapted to the particular environment. Some of those that are deposited in water are capable of surviving if they dry out. The eggs of certain mosquitoes are laid at the edges of fresh water pools that will dry up when summer comes, leaving the eggs high and dry as soon as the spring rains have stopped. Under normal conditions the pools will not again fill for almost a year after the eggs are laid. The only moisture the eggs receive must come from occasional rain and thawing snow.

Delayed hatching

In the spring following the laying of the eggs they once more come in contact with water and then hatch. However, it sometimes happens that there is a dry winter, or even two or three, and the thawing snow or spring

rains do not raise the level of the water to the "egg belt." There is undoubtedly a certain amount of drying out of the eggs and some mortality under such conditions but the majority are nevertheless able to survive. They hatch when the pool once more reaches normal height. In seasons of abnormally heavy snow-fall and deep frost it is safe to predict large broods of early spring mosquitoes because the flood conditions reach eggs that may have been laid several years previously.

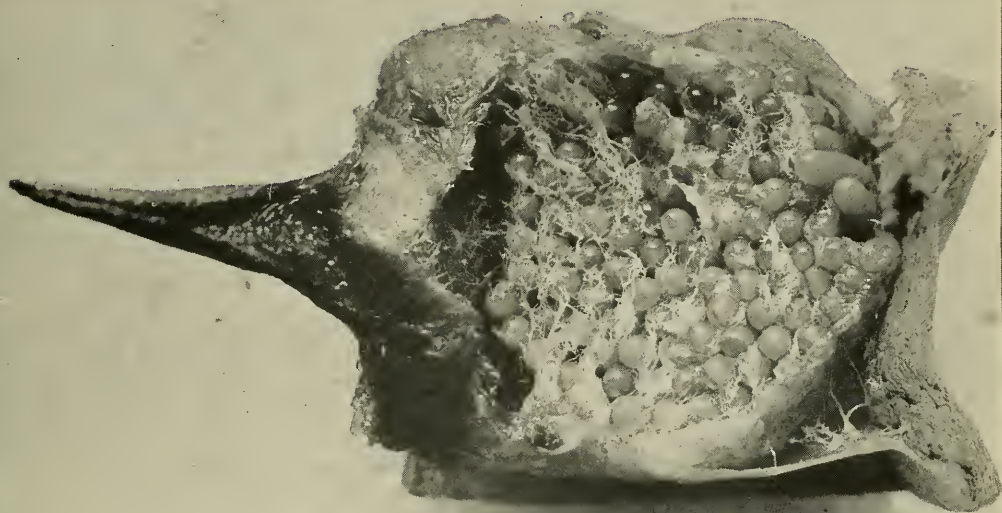
Although we are aware that the above described condition exists, we do not know the real solution of the mystery with which nature has surrounded these eggs. It would seem that there is some element connected with the eggs that allows them to hatch only under conditions found in the spring of the year, thus preventing the destruction of the species which would result from hatching in a short-lived summer pool.

Heat is, of course, deadly to insect eggs and even the most resistant can be killed by exposure for a few minutes to a temperature of 140 degrees F. Continued exposure to a temperature ten or twelve degrees above that to which they are adapted will destroy them, and the vast majority are killed by exposure to the summer sun. As a result most eggs are concealed in some way or are deposited on the under side of the leaf. Such protection is unnecessary during the winter months when the penetrating powers of the sun's rays are greatly reduced. Because of this fact we find the eggs of many insects that overwinter in this stage deposited on the twigs, trunks and branches of trees.

Numbers prove success

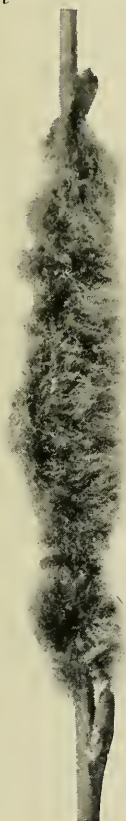
From the standpoint of survival a crucial period in the life history of any species is the period immediately following birth or the laying of eggs. It is then that the creature is usually most helpless. Without such intricately evolved habits as some of those we have discussed, the insects could not have survived to the number of more than a half million known species. There are approximately five times as many species of insects as there are of all other creatures put together. These figures alone prove, among other things, how effective are the amazing methods of insects for the care of offspring they will never see.

HOW INSECTS PROTECT THEIR EGGS



Cornelia Clarke

Insects, in order to survive, must lay their eggs where natural enemies will not destroy them and where the young larvae upon emerging will find proper food. The large, black water scavenger beetle (Hydrophilus) lays its eggs as shown above in a silken case that floats on the water. The young larvae have gills and are adapted for life among aquatic plants



Cornelia Clarke

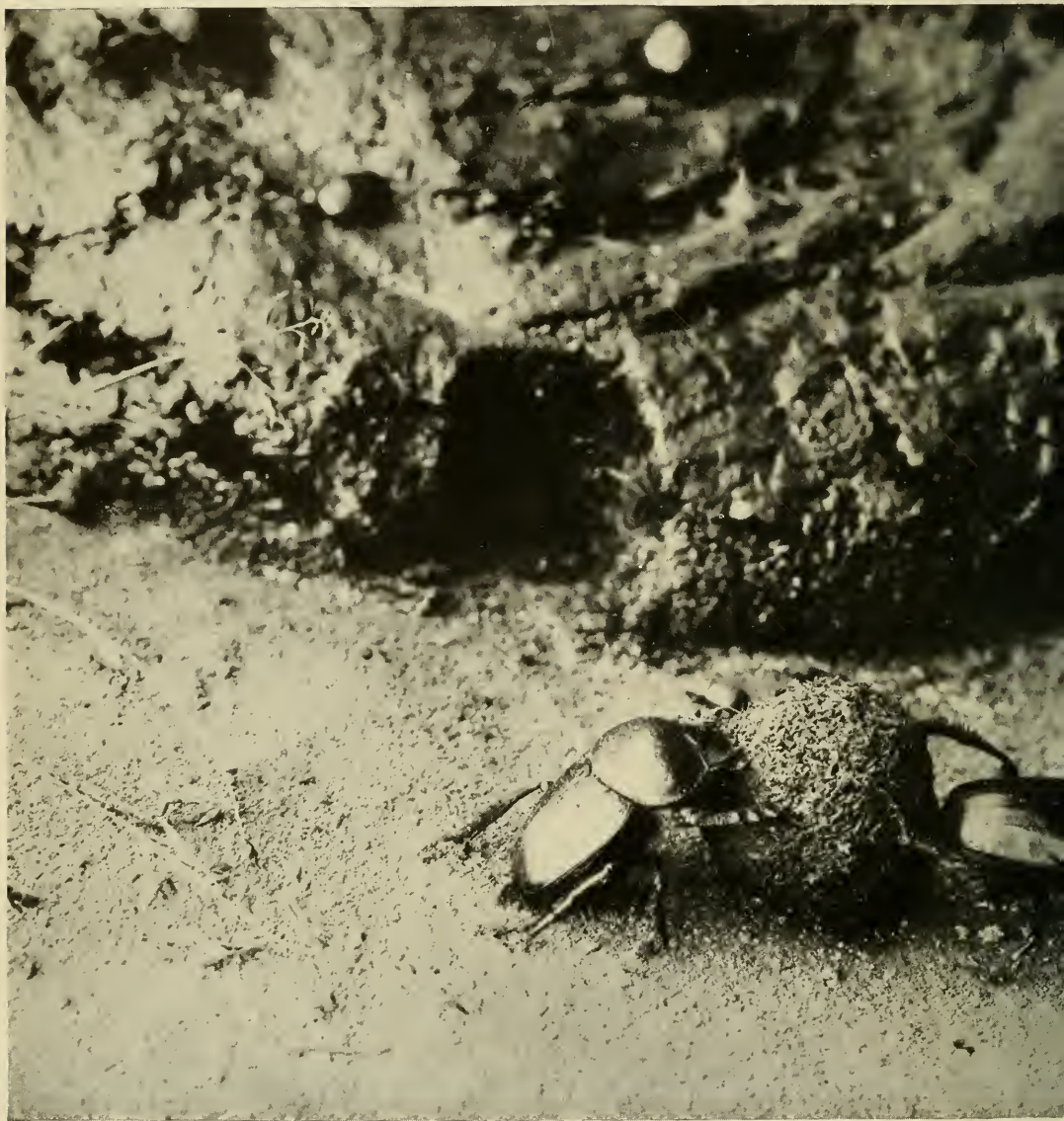
(Above) The mother water bug lays her eggs on the back of her mate. The wing covers are sealed under them and the male is unable to fly until the eggs are hatched

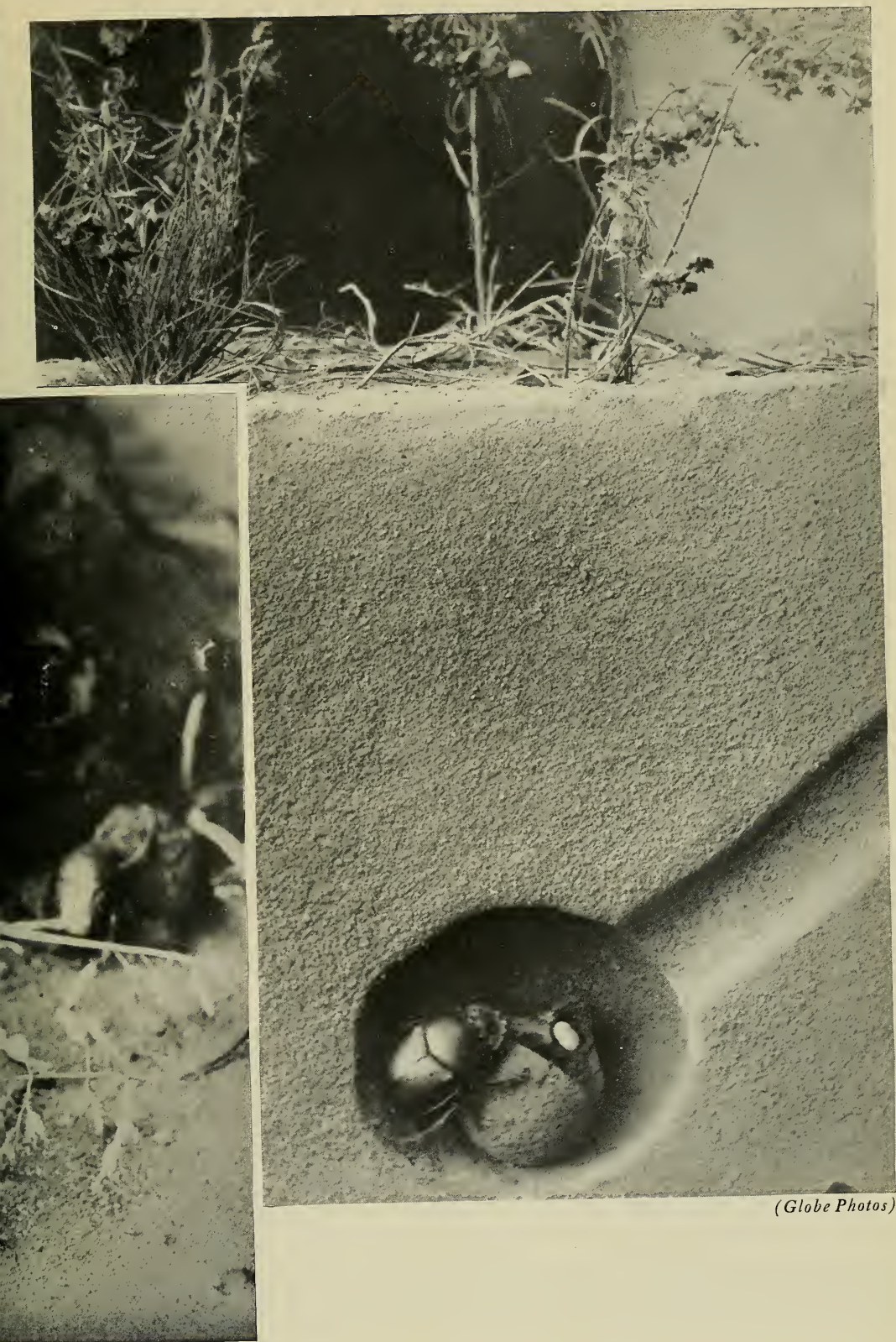
(Left) The European moth, Eriogaster lanestris, covers its eggs with hairs from its own body. The hairs probably serve to protect the eggs against parasites

(Globe Photo)

(Below) An example of the beginning of co-operative effort among insects: a male and female beetle joining forces to provision the "nest." After locating fresh dung these relatives of the sacred Egyptian scarab dig a tunnel and excavate a broad chamber. The two beetles then prepare a ball of the material, which is to serve as food, and roll it into the mouth of

the tunnel, the female going in ahead of it. (Right) Once in the chamber the female deposits an egg in the ball. In the sectional illustration shown here the ball is cut open to show the egg. Her mate waits at the surface to help her plug up the opening when she emerges. This prevents the food ball from drying out and insect enemies from entering





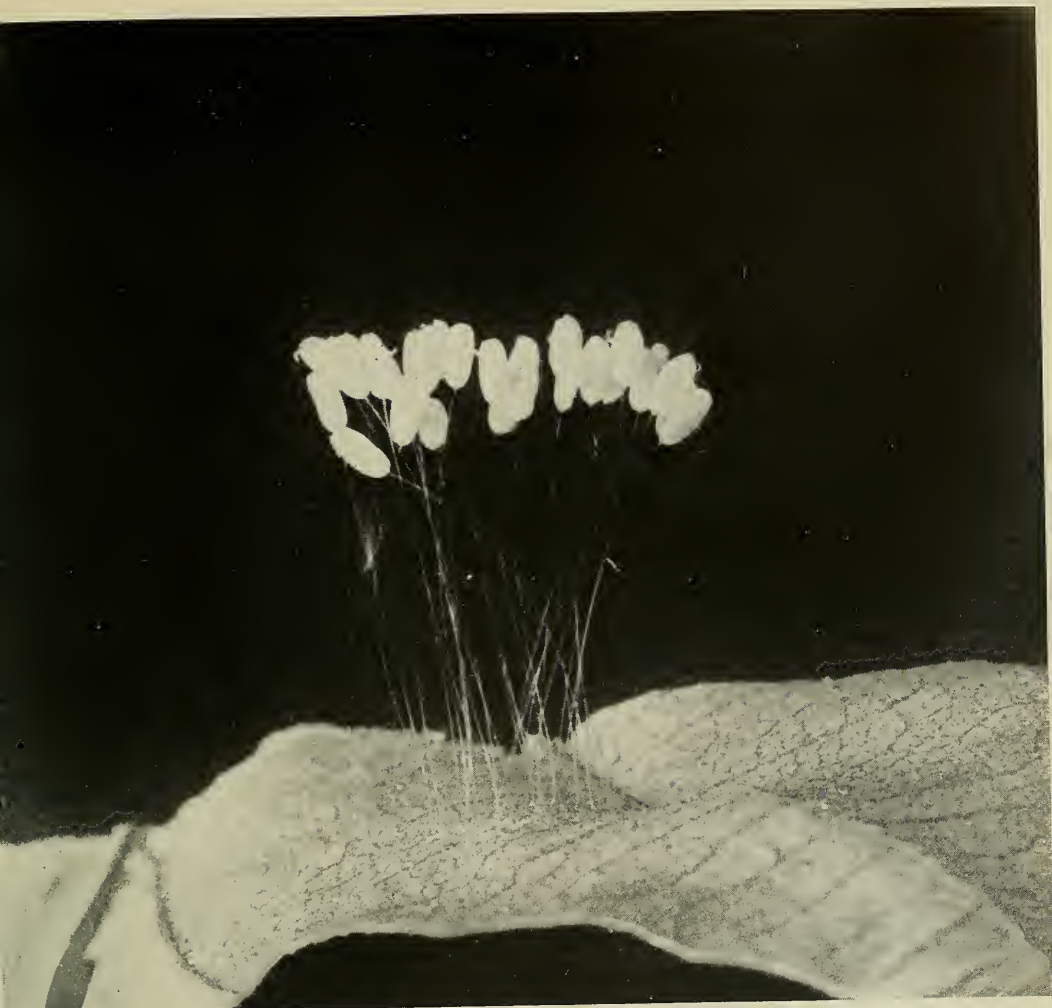
(Globe Photos)



The grasshopper shown at the left is engaged in the serious occupation of laying her eggs in the broken stem of a plant. She has forced almost the whole of her abdomen into the stem in order to deposit the eggs far inside, where they will be well protected (Globe Photo)

The paper making wasps of the genus Polistes make small, open nests that hang downward from a slender stem. The cells each contain a single egg glued to the side near the bottom and are left open so that the adult can bring food for the young (Photo by Cornelia Clarke)



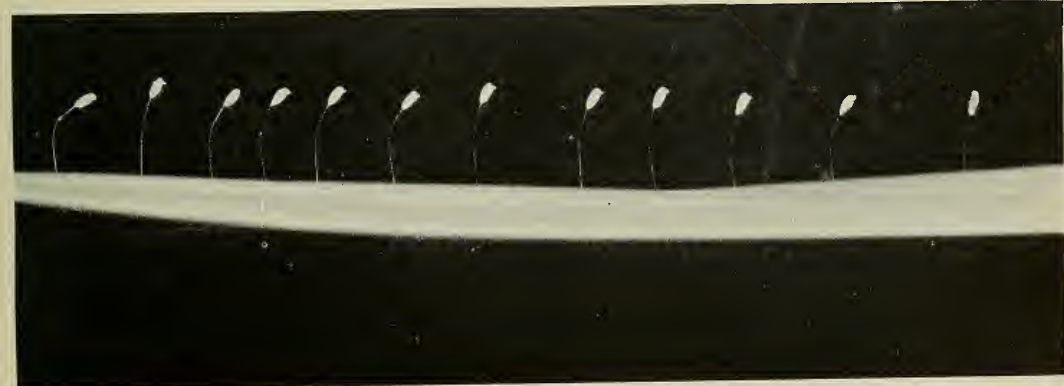


Globe Photo

(Above) The aphid lions lay their eggs at the end of hair-like stalks. If they did not do so the first hatching larvae would eat the eggs of their brothers and sisters. When planted in

a cluster the bases of the hair-like stalks are set in a spiral formation so that the eggs above are kept apart. On narrow leaves, as shown below, the eggs are spaced in a single row

Photo by Cornelia Clarke





Photos by Cornelia Clarke

(Above) Spiders, although not true insects, also protect their eggs in interesting ways. The wolf spider shown above is carrying her silken egg case. It is a bulky load, but she is able to travel quickly with it, and will not discard it until the young hatch



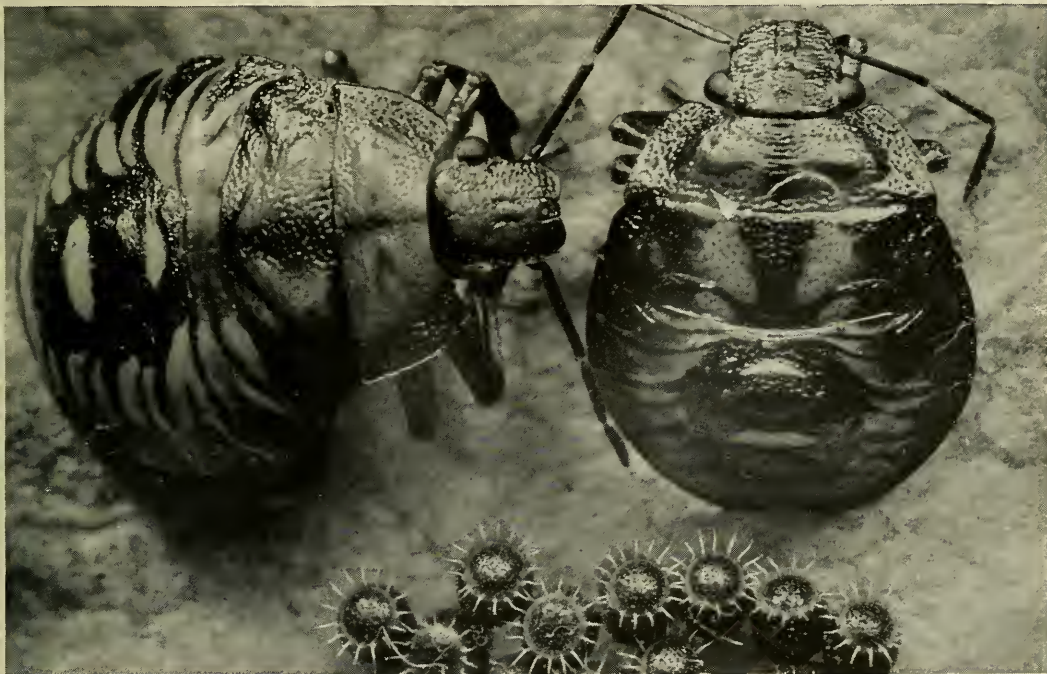
If the silken cover is removed from the eggs of the orb weaving spider they present the appearance shown above. At the left the same eggs are shown after being separated



(Above) The garden spider hangs its light brown egg sac in a network of silken threads woven among weeds or long grass. The sac is closely woven and quite tough so that the eggs are well protected against the buffeting of winter weather

Below are two young "stink bugs" which hatched from eggs similar to the spiny ones shown near them. The eggs of these bugs have a very hard shell but there is a weak ring near the top allowing the whole cap to come off

Photos by Cornelia Clarke





Sharp changes in temperature are a menace to certain insect eggs, especially in arid regions. In order to provide the eggs with even temperature and moisture, the Palestine grasshoppers bury their eggs deeply. At left shifting sands have exposed the egg-laying grounds of the grasshoppers. The projecting plugs are the material cemented by the female in the passages above the egg masses

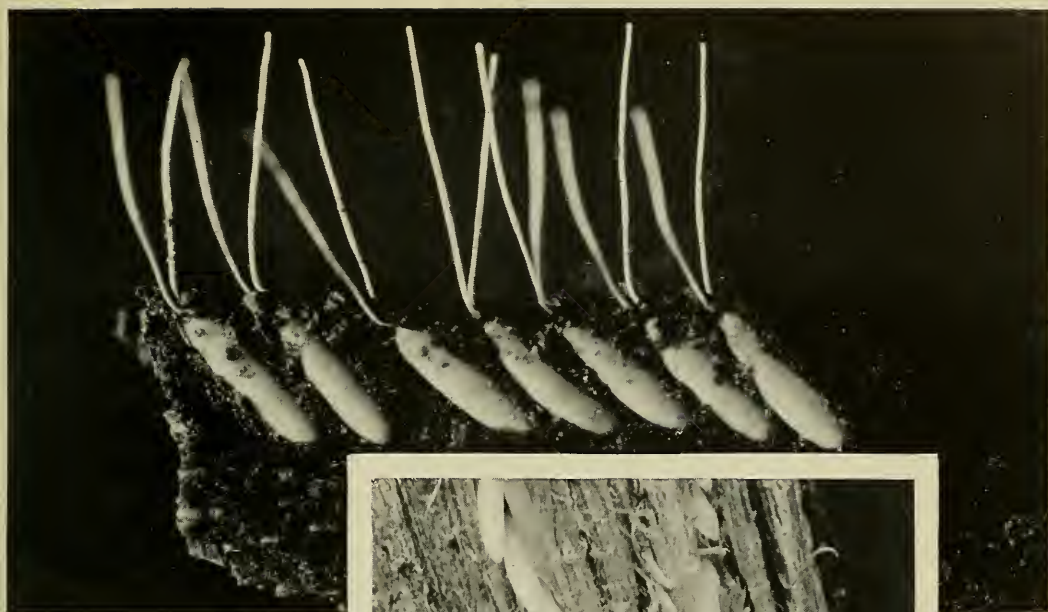
Below are shown the egg masses and the plugs above them in normal relation to the surface of the ground. The tape measure shows the almost unbelievable depth to which the female stretches her abdomen in laying the eggs



William Thompson Photos



In the close-up of a single egg mass to the left the individual eggs may be seen, together with the sand plug above. The tunnel above was occupied by the female's abdomen during oviposition

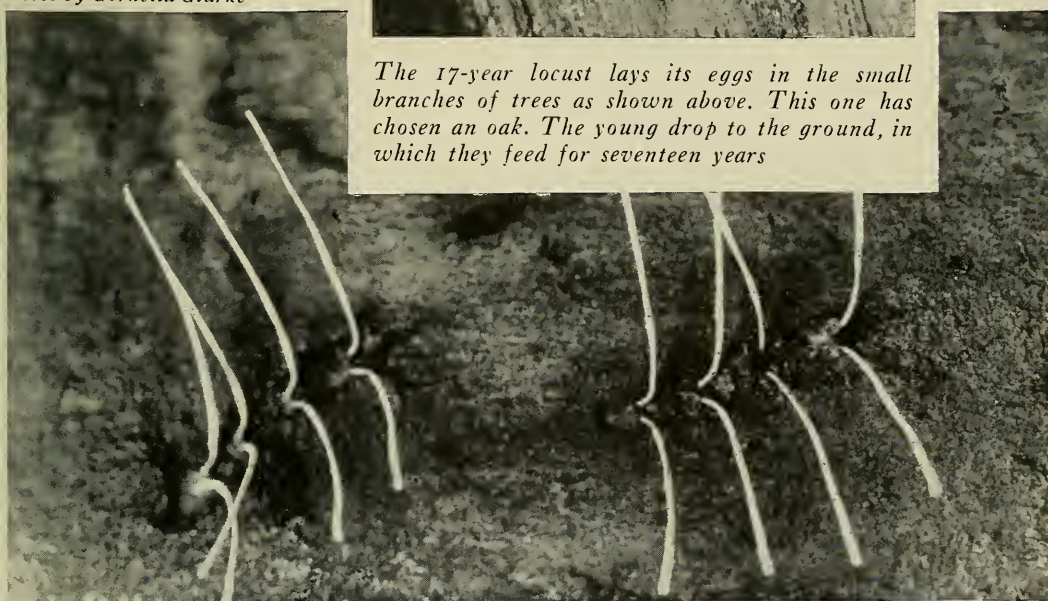


(Above) A piece of submerged wood on which an American water scorpion has laid its eggs. The two filaments that project from each egg into the water are the only indication of the presence of the eggs. At the bottom of the page these filaments are shown as seen from above

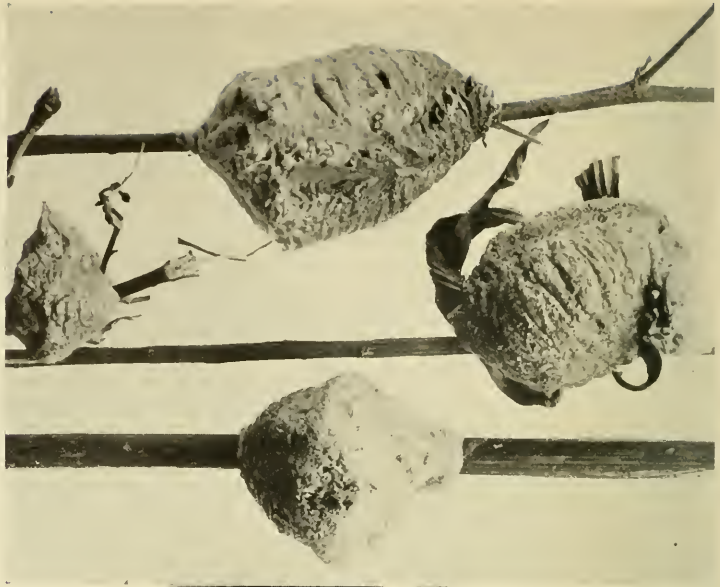
Photos by Cornelia Clarke



The 17-year locust lays its eggs in the small branches of trees as shown above. This one has chosen an oak. The young drop to the ground, in which they feed for seventeen years



The eggs of preying mantids are protected by a tough covering produced by the mother, shown at the right. Each kind of mantid has a different shaped egg mass



(Right) The spiral egg band of a European relative of the American tent caterpillar. Despite the protection offered by the substance surrounding the individual eggs they are subject to attack by small parasites Clarke Photo

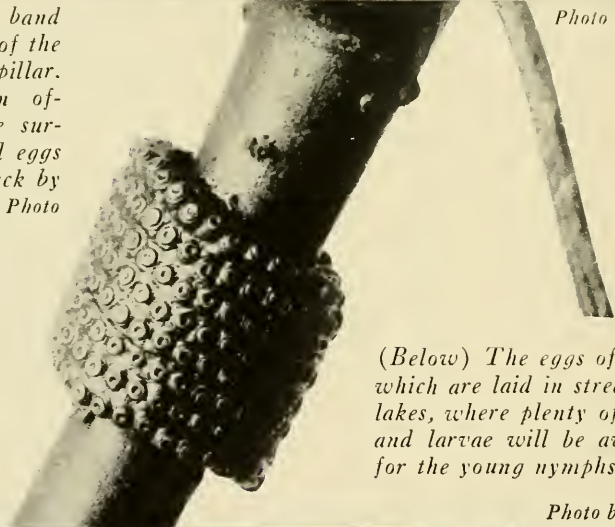


Photo by Cornelia Clarke

(Below) The eggs of the dragon fly, which are laid in streams, ponds, and lakes, where plenty of aquatic insects and larvae will be available as food for the young nymphs

Photo by Cornelia Clarke



Big Money of Yap

In these tiny Pacific isles gigantic stone coins change hands in the market. A six-foot wheel buys villages and plantations

By WILLARD PRICE

PERHAPS the strangest and largest coins in the world are those to be found in isolated Yap, a small group of islands about eight hundred miles east of the Philippines.

It would doubtless cause surprise on Broadway if a man were to come down the street rolling a coin as tall as himself. But in Yap such coins are common. Some are indeed twice this size. Place one such on edge, and a tall man must stand on a tall man's head to reach the top.

In the center of each coin is a round hole. In an important coin, this is as large as a man-hole. When the coin is to be paid, a tree is thrust through the hole and a crew of men partly lift and partly drag the coin over the ancient stone-paved jungle trails to the creditor.

In the port town, Japanese money is used—for Yap is under the control of Japan. But in the jungles of the main island and in the outlying islands of Map and Rumung Japanese money is rarely seen. The ancient stone money is still current.

Shopping with stones

While living in the thatch hut of a native king in a jungle village, studying native customs, I was amused to see how shopping was carried on by the use of stone money. The queen, when she wished to go to the trader's, did not sally forth with a pocketbook. She went down the shore path under the palms followed by a husky slave sweating under the weight of a three-foot stone disc supported on the shoulder by a bamboo pole thrust through the hole.

The village trader accepts such currency cheerfully. Of course he cannot exchange it for foreign goods. No bank in Tokyo, London, or New York would recognize his slab of rock as collateral. But he can pay it to some other native for coconuts.

A chief admired one of my hats.

"May I have it?" he asked. "I will pay for it."

"Please take it—as a gift," I urged.

He would have none of that. He paid, and paid handsomely. Four slaves groaned into our courtyard with a coin measuring four feet and weighing about two hundred pounds. My bewilderment as to what to do with it was soon relieved. The next day the chief took it back and returned the hat. His friends had made too much fun of him in this outlandish headgear. For hats, and most other articles of clothing, are strange to the natives of Yap.

Why such unwieldy coins?

How did Yap get such an unwieldy coinage? There is no record, since the Kanakas of Yap have no written history. But there is a native tradition according to which, some hundreds of years ago, one of the more reputable gods thought to cause dissension among men. They were at peace because they had nothing to war over. He would give them something to war over. Money.

He whispered to a king of Tomil (one of the sections of the main island of Yap) a plan to make him great and powerful. Obedient to the heavenly vision, the king sailed south over unknown waters to islands of the Pelew group. There he found shining rock (calcite) which the malicious deity instructed him to have his men hew out with their shell-axes into flat

pieces rounded like the orb of the full moon. These were loaded into the canoe and brought to Yap, not without many perils. The god cast a spell over the people that caused every man of them to desire nothing so much as one of these heaven-sent stones. To obtain them, they paid to the king of Tomil great riches in the form of coconuts, canoes, and houses. So the wheels became a medium of exchange for goods.

And those who tell the legend go on to say that there has been no peace in Yap since then. The golden (or stone) apple of discord disrupted the island paradise. Formerly there had been little covetousness; for there was little to covet. No man desired his neighbor's coconuts for he had his own. There was food enough for everyone and no one wanted clothing. Greed was born when money came in. Quarreling began among relatives as to who should inherit which rock. Feuds arose between neighbors, wars between villages. The elders of Yap, ignorant of the fact that the Bible designates the love of money as the root of all evil, have become convinced of this from bitter experience.

"Nine quarrels out of ten are over money," one told me. So we are given to suppose that the god had a great laugh at the expense of the people of Yap.

There was only enough of the first money to be tantalizing. Expeditions set out to get more. They went not only to Pelew but to Guam where an even finer stone could be obtained. But it is four hundred miles to Guam and the seas are stormy. Many canoes were lost, particularly on the return voyages when they were loaded to the danger point with great stone wheels. It was not uncommon for twenty canoes to set out for Guam and only one to return.

No counterfeiting

Of course the difficulty and danger in securing the stone kept up its value. There could be no counterfeiting, for there was no similar stone to be found in Yap. It is a calcite or crystallized carbonate of lime which forms in veins filling the cracks in limestone or other rock. There is nothing inherently precious about it. It has value to the Yap native only because it is hard to get and because it is the accepted medium of exchange.

If these goings-on amused the god, they also amused an Irishman named O'Keefe.

I found a cross-eyed old native sailor with the shamrock tattooed on his brown skin who had sailed with Captain O'Keefe for years. He told me the story.

Buccaneer O'Keefe cast anchor in Yap harbor during the Spanish rule (a rule that was largely characterized by the lack of any) and proceeded to look the natives over with a view to making what he could out of them. He soon found that they would give copra, fish, anything they possessed, for stone money.

Very well, stone money they should have. He had heard that large pieces were especially in demand. That was where he fitted in. On his schooner he could transport pieces many times as large as could be carried in canoes.

"He sailed to Pelew and went to the king," my informant related. "He asked for many men to help dig stone money.

"The king said, 'What will you give?'

"The Captain gave rope. He gave paint to paint the bodies of the dead. Dye to color lavas (cloth garments wound around the waist). And some guns. He promised to give more when the work was done.

"The men of Pelew dug . . . many months, years. Small stones took little time. But it took two years to dig out a great wheel.

"We kept taking the wheels to Yap and selling them to the natives for copra.

Trouble in store

"But the chiefs of Pelew became angry because Captain O'Keefe paid no more and was cruel to the men. They looked for a chance to punish him."

The opportunity came when the Captain was wrecked in the Pelew group on the island of Babeldaob at Alklung. The natives seized all his goods. But this punishment was not enough.

They would give him some of his own medicine. They lashed him to a tree and brought out a cat-o'-nine-tails salvaged from his own ship. They flogged him.

After his release he lost no time in lodging complaint at Hongkong. A warship visited Pelew and demanded an indemnity in the form of large quantities of copra and bêche de mer (sea slugs) from the offending village of

Alklung. When the indemnity was not paid, two more warships came, landed their men and burned the village to the ground.

After a long series of ruthless, picturesque, and piratical exploits, Captain O'Keefe one day stocked his schooner at Yap for a long voyage, kissed his two wives good-bye, and sailed away. He never came back. Some say that he went to an island known only to him, for he was an excellent navigator and knew the South Seas as few men did. Others suppose that he was lost at sea.

A two-ton coin

However that may be, he left behind him monuments that will stand to his memory for thousands of years. The largest coin of his minting that I saw measured twelve feet and its weight was estimated at about two tons. Flip that over the counter! But the greatest of all is said to lie at the bottom of Yap harbor. While being transferred from the schooner's deck to a raft, it slid into the water. The old men who saw it swear that it was twenty feet across . . . but that may be a "fish-that-was-lost" measurement.

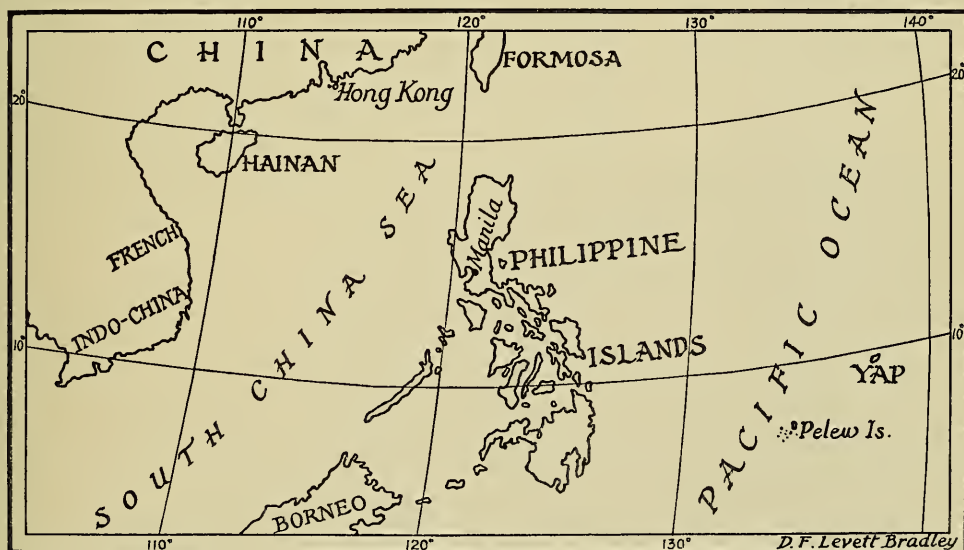
Since this monolithic money is so cumbersome, barter is used for most small transactions. Goods are traded for goods. There are accepted values, recognized as standard. Two

coconuts sell for one match. Ten nuts will buy one roll of bread. Ten nuts are the equivalent of one pack of Golden Bat cigarettes. The man who has brought his nuts from a great distance may demand and get one or two cigarettes extra. Ten leaves of tobacco buy twenty-five nuts. One cider-bottle of petroleum goes for twenty nuts and a beer-bottle of petroleum is paid for forty nuts.

The natives sell chickens, eggs, pigs, in the same way—for petroleum, phonographs, harmonicas; not for money. They do not understand money in the form of small silver and copper pieces, so insignificant compared with their majestic coins of stone. They cannot get the values through their heads. Too much mathematics is involved. Besides, who knows how long this foreign money will be good? First Spanish money came. Then German money, and the Spanish was no good. Then Japanese money, and the German was no good. But Yap money is always good. It goes on forever.

Other moneys

Stone is not the only form of Yap money. Shells of the pearl oyster are strung together and used as currency. Bags of copra are used. Also the remarkably fine lava-lavas produced by the artists of the neighboring island of



Yap, where stone coins are used, lies 800 miles east of the Philippines

Mokomok. A sack of these lava-lavas was kept as one of the chief treasures of the "All-Men-House" (council house) in our village. There was no thought of opening it and using the garments. It was kept intact to be paid sometime to another village for a canoe.

But barter and these lesser currencies are used for only small deals. For a great one, stone money comes into play.

The foreigner who regards these stones as of little value will be sharply disillusioned when he tries to buy one. He must pay goods to the value of about seventy-five dollars for a wheel from Guam a foot in diameter! The Pelew wheels cost less. A poor specimen, waist-high, is valued at four thousand coconuts, worth in the islands about twenty dollars. A stone as high as a man is worth many villages and plantations, and the stones two-men-high are considered to be beyond price.

Riches in the front yard

The great stones are not owned by individuals but by communities. They are displayed outside the All-Men-House which thereby acquires the native name, "Febai" (Money House).

Private homes are flanked with smaller pieces from two to five feet high. The Yap resident would consider it just as strange to take his money inside the house as we would to leave ours in the yard. "How," he would say, "can anyone see your money if you keep it in the house? Moreover, there would scarcely be room left for the family."

However, the small pieces, six inches or so in diameter, are kept indoors. Not only because they would be too easily carried away if left outside; but because the householder would be ashamed to show them. It would be like displaying pennies. He would be thought a poor man.

Therefore large stones are in demand. Rather than accept small wheels, the creditor prefers to let the bill mount until he can be paid with a handsome wheel great enough to attract real attention as it leans against his house or against the stone platform upon which his house is built.

Such coins are rarely stolen. It is hard to slip away with a half ton of rock. Still it could

be done while the people of the house are absent. But where could one take the booty? It would be futile to remove it to some island outside of the Yap group because such currency is not used elsewhere. If it were kept in the Yap islands it would be traced. There are no inscriptions on these coins by which to identify them; but the details, irregularities, and measurements of every wheel are memorized by the owner. He would recognize his wheel anywhere. The larger wheels even have individual names and are known by name and appearance to everyone in the islands. They are even better known than people; for people come and go, are born and die, but these familiar faces remain from generation to generation. Every wheel has its story, usually a story of blood, of fighting between villages for possession of the piece of rock, or of feuds between families, or of attempts to steal and hide the money, or of the killing of its owner by poison or a spear-thrust. Most of the tales of trouble and terror in Yap seem to cling like moss to these old stones. There are records of half the men, women, and children of the island being slaughtered in a money foray.

Inflation

Today the mint is idle. No more stone money is being "coined." This may be due partly to the growing competition of Japanese money. There is a greater reason. The population has shrunk to half its former size, while the supply of money has remained the same. So there is more than enough to go around. In other words, Yap's currency is inflated. Also, the value of labor has risen, so that it would cost more to go to Pelew and dig out new wheels than the wheels would be worth.

Although the use of the wheels as currency is slightly decreasing, the hoarding spirit will long keep up the value of the old stones. As each family dies out its stones are quarrelsome claimed by others, still giving delight perhaps to the malicious god aloft. As house after house is abandoned, the wheels pile up around the homes of the survivors. As a result of wars, dissension, and disease, the race may die out. But the great stone wheels will remain, odd monuments to the evil of the love of money.

Big Money of Yap

(Right) In this tiny group of Pacific isles, gigantic stone disks like the twelve-foot piece shown at the right serve as coins. One a foot in diameter is worth up to seventy-five dollars, and those two-men high are beyond price. The difficulty and danger in securing the stone from other islands is the basis for the value of these strange coins



(Left) A scene in Yap: an All-Men-House or Council House. Coins not owned privately but by the community are displayed outside this sort of building, which thereby acquires the native name "Febai," meaning money house

When a coin is to be paid, a pole or tree is thrust through the hole in the center and it is carried or dragged over the ancient stone-paved jungle trails to the creditor





It is the custom to display one's stone money in the front yard. The coins are rarely stolen because they can always be identified in the islands and the thief could not pass them in any other part of the world. The bundle in front of the man at the left also represents wealth. It contains valuable lava-lavas, cloth garments that are wound around the waist

(Right) A woman offering a string of shell money for a bottle of petroleum: a case where barter takes precedence over the cumbersome stone money, a piece of which lies idle in the background



An enormous coin said to be worth many villages. Today no stone money is being "coined." But the hoarding spirit will long keep up the value of the old stones

Science in the Field and in the Laboratory

Back from Panama—Museum Art Show—Glacier Bay—Reptile Hunt—Children's Fair

Entomologists Return from Panama

Curator Frank E. Lutz, Doctor W. J. Gertsch and Mr. Wm. C. Wood of the American Museum of Natural History spent February and March in very successful field work on the butterflies and moths of Panama. Two regions were selected in which to do intensive collecting. One was Barro Colorado, the large island in Gatun Lake, Canal Zone. It is almost entirely covered by a rather dense jungle typical of the low hills near sea-level in Central America and is the laboratory of the Institute for Research in Tropical America. The other was on the western slope of the Volcano (extinct) of Chiriqui near the Costa Rican border. Headquarters there were at an altitude of about 4200 ft. In addition to the high-altitude jungle, this region has a large area of naturally open country. It furnished a good contrast with Barro Colorado. The faunas of the two regions differ markedly, a condition which not only resulted in the expedition's getting a large range of species for the Museum's collection but also will, it is hoped, help in understanding the geographic distribution of insects in Central America.

Frederick H. Douglas

Mr. Frederick H. Douglas of the Denver Art Museum, Denver, Colorado, recently visited the department of anthropology. Mr. Douglas is distinguished for his knowledge of American Indian Art and for having built up in the Denver Museum one of the most important collections in the world. In connection with this work, he has developed the educational use of these materials to a degree not realized in other cities. His work attracted so much attention that it has been supported by the Carnegie Corporation and other foundations interested in the promotion of art and art education. Finally, Mr. Douglas has prepared and issued a series of about 100 leaflets dealing with the technology and art of various American Indian tribes. These are now recognized as classics and have been distributed to every country in the world.—C. W.

President Davison back from India

Mr. F. Trubee Davison, president of the Museum, and Mrs. Davison returned April 21 from a three-month trip to India. Next month NATURAL HISTORY is planning to run an illustrated article describing the interesting experiences Mr. Davison had on this trip.

The Arthur Lecture on the Evolution of the Human Brain

The fifth annual James Arthur Lecture on the Evolution of the Human Brain will be given at the American Museum of Natural History on the evening of May fifteenth. Dr. Samuel T. Orton, Professor of Neurology and Neuro-Pathology in Columbia University, will speak on "The Language Area of the Human Brain and Some of Its Disorders." Professor Orton illuminates his subject by the following brief explanation:

"The exclusively human faculty of language (speaking and understanding speech, reading and writing, and the use of meaningful gestures as in sign language) is controlled from a part of the human brain which is enormously expanded as compared with the similar area in the highest apes. It is also peculiar in that only one side of the brain is necessary for normal language functioning. A very small area of destruction by injury or disease will give extensive disorder of speech or reading if it strikes in the language zone and in the controlling or dominant side. A similar or even larger destruction in the non-dominant side will have no effect on language."

Experimental Biology

At a recent meeting of the American Association of Anatomists held at Duke University, Durham, North Carolina, several phases of the research work of the Department of Experimental Biology were presented.

Dr. G. K. Noble reported on his studies of the relation of brain structure to social behavior of vertebrates. A large part of the fore brain of vertebrate animals is formed by a mass of tissue

called the corpus striatum. The function of this structure has not been fully understood. Doctor Noble showed that in both birds and fishes it serves as a mechanism for co-ordinating instinctive behavior patterns, especially those concerned with social life.

Dr. William Etkin took part in a symposium on the relation of hormones to growth and differentiation. The rôle of the pituitary and thyroid glands in relation to development has in recent years been a matter of extensive investigation. Doctor Etkin discussed the function of these glands in the development of Amphibia.

The American Museum's Annual Art Show

Many people show surprise when told of an annual Art Exhibition at a Museum devoted to Natural History. "Art belongs in an Art Museum" is their instant judgment, and herein lies an unconscious and therefore doubly sincere compliment to the men and women who serve science as artists. Science deals with facts and it is the work of Museum artists to record them. From the figures in black and white line that accompany the first brief reports on material new to science, to the more elaborate work in full color illustrating the final memoirs and monographs of completed research, the artist helps bring the wonders and beauties of our world closer to all. Again, in the exhibition halls, artists specialize in portraying nature so skillfully that one visitor, viewing a group for the first time, commented on the deadness of a wild dog, killed by a sambur deer. In reality, the deer and the attacking dog pack are all as dead as the "dead dog" lying at the base of a plaster rock, bathed in the sunlight of a painted background showing a spot in Asia thousands of miles away.

Thirty-seven contributors including regular staff artists, WPA artists, and other workers are represented by 258 exhibits in the American Museum's annual spring art show.

The paintings cover a wide range of interpretation. There are vigorous, colorful oils of animals and delicate, clean-cut marines that breathe of the briny deep. An old shack forms the inspiration for two paintings by the same artist, one in oil and the other in water color. There are sketches of badlands, the first attempt in oil to record for science the beauty of fossil-bearing formations; and water-colors of foreign scenes, unique for a certain mystic quality seldom encountered. Illustrations of material studied through a microscope and carried out in water color show an unusual use for this medium. Animal sketches in black and white, beautiful studies of insects, fish and shells show the many types of illustration done by museum artists.

The sculpture ranges from portrait heads, of intricate oriental design, to bold simple work in various media. Wood carvings include a young colt, portrait heads and decorative panels. Miniature group models and decorative tiles, a sailing ship model, original designs carried out in gold and silver further emphasize the unusual versatility of the artists employed by the Museum.

—J. C. GERMANN.

The Glacier Bay Monument

The Glacier Bay National Monument in southeastern Alaska, established eleven years ago by President Coolidge, includes tidewater glaciers of the first rank in a setting of magnificent fiords and lofty peaks and a visible demonstration of what was happening all over northern North America at the close of the last Glacial Period—the slow retreat of the ice and the coming in of a new vegetation and a new animal population. Numerous well-preserved relics of interglacial forest make it possible to compare the life and development of the areas which animals and plants are again colonizing with these older associations.

Unfortunately, House Resolution 9275, introduced January 3, 1936, would open up this monument for mining purposes under the same conditions in which the public domain is open. As pointed out by the Ecological Society of America in a letter sent Dr. H. E. Anthony by the American Planning and Civic Association, the glaciers would be in little danger, but even a sparse mining population would result in the cutting of the young trees, the use of the interglacial forest relics as firewood, and the killing of the animal population.

The association requests that friends of conservation write protesting against passage of this bill, H. R. 9275, to Hon. Rene L. DeRouen, Chairman of the Committee on Public Lands of the House of Representatives, and to Hon. Robert F. Wagner, Chairman of the Committee on Public Lands and Surveys in the Senate.

Reptiles and Amphibians

Mr. C. F. Kauffeld, together with two friends of the department, recently returned from a reptile hunting expedition in the southeastern states, particularly Florida.

Although heavy rains which flooded the countryside hindered the work somewhat, they succeeded in securing fifty species, thirty-six of reptiles and fourteen of amphibians. Among the notable specimens were the rare yellow-lipped snake, *Rhadinea flavilata*, and the short-tailed snake, *Stilosoma extenuatum*. Only one large diamond-back rattlesnake was found throughout the trip.

The Hayden Planetarium

A new Planetarium lecture on THE PLANETS will start Sunday, May 3, to continue during the entire month of May. This lecture will present in detail the various aspects of the planetary bodies of the solar system, illustrated not only by the Planetarium instrument itself, but also by the finest planetary photographs made through the world's great telescopes. In addition to the daily and annual motions of the sun and planets, the lecture will include explanations of such phenomena as direct and retrograde motion, inferior and superior planets, morning and evening stars, the Zodiac, and Bode's law. A general view will also be presented of the night sky in May.

Mr. J. V. McAdam, an enthusiastic Amateur

Astronomer, has lent two reflecting telescopes for exhibition in the Planetarium during May. Both of these instruments were made by Mr. McAdam himself. The larger one has a mirror of 12½ inches diameter which is coated with aluminum. Accessories used in the construction and operation of this telescope are also on exhibition. This is a particularly interesting group in view of the fact that some five thousand amateur astronomers in this country have built their own reflecting telescopes.

During this month there will be an exhibit in the Planetarium of astronomical paintings by Mr. James Perry Wilson. This collection includes paintings of solar and lunar eclipses and various views of the planet Venus in the evening and morning sky.

Amateur Astronomers Association

During May the following lectures and meetings will be held by the Amateur Astronomers Association in the large auditorium of the American Museum of Natural History. All those interested are invited most cordially to attend, as the meetings are open to the public free of charge.

May 6—Dr. Joseph Razek, University of Pennsylvania—"Color and Its Measurements."

May 20—Annual Meeting—Presentation of new by-laws. Election.

Short address by Dr. Clyde Fisher, President.

Junior Astronomy Club

A jubilee meeting on the ninth of May will bring the seventh season of the Junior Astronomy Club to a close. Beginning in the afternoon with a special lecture on "The History of Astronomy" by a club member, Lois Saphir, the meeting will close with outdoor observations in the park. A member of the staff of the World Calendar Association will address the club on "What Is Wrong with the Calendar?" Retiring president Robert Fleischer will be succeeded by his sister, Ruth Fleischer, the first girl to direct the activities of the club since its organization.

American Museum Lectures

The following free lectures and motion pictures are scheduled for the month of May:

MOTION PICTURES: Saturdays, at 2:00 o'clock; May 2, "Along the River Nile"; May 9, "Almost to the Pole"; May 16, "Frontier Woman"; May 23, "Medieval Moderns"; May 30, "Dixie."

SCHOOL CHILDREN: Fridays at 10:30 o'clock; May 1, "Birds of Spring"; May 8, "Sightseeing in China"; May 15, "Nanook of the North"; May 22, "Sequoia."

Two lectures for students in elementary biology and general science are to be given Tuesdays at 3:40 P. M. May 5, "Wild Birds and Their Human Appeal," Mr. Paul B. Mann; May 19, "Are You Going to Camp This Summer?" Miss Farida A. Wiley. The last lecture this season for students in general and advanced biology will be "Heredity and Environment as Factors in Life," given by Dr. George C. Wood, May 12, at 3:40 P. M.

Educational Broadcasts and Tours

The program for the American Museum Educational Broadcasts and Tours over WNYC during May is as follows:

May 7—The Story of Eclipses; May 14—The Pleasures of Astronomy; May 21—Canada—Our Northern Neighbor; May 28—China—Topsy Turvy Land.

The first two lectures will be given by Mr. Robert R. Coles and the ones on Canada and China by Mr. John R. Saunders. In June Mr. Saunders will lecture on Siberia, on Japan, and on the Philippines. The broadcasts are given on Thursdays at 5:30 P. M. and the tours of the Museum illustrating the lecture are planned for the Saturday following the broadcast at 3:00 P. M., but announcement about the tour will be made at each broadcast. The tours are free and all are invited.

Children's Science Fair

The eighth Children's Science Fair, sponsored by the American Museum of Natural History, under the auspices of the American Institute, will open in Education Hall May 17 and continue through May 24. Last year more than a thousand exhibits were made by students in the New York City schools, from the elementary grades through the senior high schools. Some 40,000 to 50,000 persons visit the Fair each year.

The exhibits are entered under ten classifications: Stars and the Solar System, Earth Studies, Plant and Animal Life, Biology, Physics, Chemistry, Conservation, Industries, History of Science, and Energy.

Exhibits in Branch Libraries

Many members who live at too great a distance to permit frequent visits to the Museum or whose programs of work or study conflict with Museum hours, may be pleased to learn about the interesting collections which are being shown under the auspices of the Museum's Department of Education in the branch public libraries in the boroughs of Queens, Brooklyn and Manhattan. Among these exhibits are collections illustrating the material culture of the native African tribes, North American Indians, Eskimo, Chinese, Mexicans; a collection of costume dolls; textiles; masks of the Javanese, Africans, Chinese, Tibetans and Japanese; astronomical exhibits; miniature habitat groups; a collection of beautifully colored butterflies; "Sea People and Their Castles"; and a collection of minerals used for gems and costume jewelry.

Bird Study Courses

Mrs. Gladys Gordon Fry, known to bird lovers and students as "The Bird Lady," opened her fifth series of bird and tree walks in Central Park in April, under the auspices of The American Museum of Natural History.

Central Park is one of the best places in the country to study migratory birds, and New Yorkers have a rare opportunity to observe many different species in a restricted area.

An exhibition of the art work of the elementary and junior high schools of Greater New York was held in Education Hall of the American Museum from March 29 to April 19 under the supervision of Miss Edith L. Nichols, assistant director of fine arts in the New York City schools. The major part of the exhibit displayed creative painting and pictorial projects relating to the geography of New York City.

An Appointment

Mr. Paul B. Mann, associate in education at the American Museum since 1928, has been appointed chairman of the Standing Committee on Science and of the Science Council of the City of New York, the highest scientific position in the City's educational system. These two bodies have been established to assist in meeting the problems of science teaching in the secondary schools and to consider the broad aspects of science instruction.

By the death of Peter C. Kaisen on March 18, at the age of sixty-six, paleontology has lost one of its outstanding technicians. In 1897 Mr. Kaisen, a Dane by birth, was a section foreman on the Union Pacific Railway at Aurora, Wyoming, where he came in contact with the American Museum expedition then inaugurating dinosaur work along the famous Como Bluff. Next year he joined the Museum party working in that region and remained with the Museum until his death.

For several seasons Mr. Kaisen engaged in the exploration, under the direction of Dr. Barnum Brown, of that richest of all dinosaur fields, the Red Deer River Valley of Alberta. Later he made expeditions to Alaska and Mongolia and recently worked in the Lower Cretaceous fields of Montana and Wyoming. Through his energy and skill, both in the field and in the laboratory, and his loyalty to the Museum, Mr. Kaisen placed the Department of Vertebrate Paleontology very much in his debt.

RECENTLY ELECTED MEMBERS

A REPORT from the membership department lists the following persons who have been elected members of the American Museum;¹

Patron

Mr. Beverley R. Robinson.

Fellow

Mr. William W. Conrad.

Life Members

Miss Rose Dougan.

Messrs. Townsend Lawrence, Daniel C. Pease.

Annual Members

Mesdames Samuel Shipley Blood, Charles M. Clark, Margarita Derfelden, George R. Fearing, George H. Hazen, Dora R. Isenberg, Walter Nowill, Henry Parish, Charlotte A. H. Smith, William G. Thayer, Jr.

Misses Sue E. Garis, Clara S. Pulsifer, Adele Frances Siegel.

Doctors Mary H. Layman, D. W. Palmer, Geo. A. Wyeth.

Professor Henry E. Crampton.

Messrs. Harold L. Alling, William R. Cady, H. D. Chapin, Sidney A. Hassel, Alfred B. Holt, George Huling, M. A. Monroe, T. Albert Potter, Frederick H. Rike, Frank C. Rude, Bernhard K. Schaefer, Percival C. Smith, A. C. Stamm, Harry H. Warfield, F. L. Yarrington.

Associate Members

Mesdames Gardner Abbott, Richard S. Austin, Leland V. Baker, John Barker, Edward Warren Beach, C. H. Bentley, Anna Voorhies Bishop, Francis E. Bishop, J. H. Blizard, Charles R. Blyth, Gretchen Burleson, Frank Coleman, Charles A. Day, Margaret Power Drum, E. P. Eastman, Mary L. Farraher, Harry H. Fetter, Mary G. Ford, W. W. Gaar, Frederic Gooding, E. M. Green, Henry Theodore Hagstrom, Fannie Harmon, Addie W. Harrison, M. G. Houghton, John H. Hollis, W. L. Hunton, Edward S. Jamison, Luman W. Johnson, Arthur W. Johnstone, Myra W. Kennett, Ada Latham, Geo. L. Lingner, Ruth White Lowry, T. D. Mabry, Daisy Macdonald, Jas. N. MacLean, T. B. Masterson, Leslie M. Mattingly, F. W. McAllister, Frank B. Moses, Harry Loomis Munger, Mary S. Parsons, Charles L. Paulson, Jr., Elizabeth R. Powers, Babette Ramsey, F. E. Richter, Loring G. Robbins, A. M. Schaefer, Sherwood Winslow Smith, William Sztinick, N. A. Thompson, Linnie Tickell, L. F. Timmerman, E. B. Tyler, Camille T. Wagner, J. McLean Walker, Jefferson Brooks Walters, J. F. Wenk, Russell White, Lois E. P. Willis, B. A. Young.

Misses Rosabel Allin, Virginia Armstrong, Dorothy Bartol, Marie Gignoux Bates, Katharine Beverley Bayton, Bertha Forbes Bennett, Ida E. Bliss, Elizabeth Bogart, Mary G. Brown, Laura Buterbaugh, H. Virginia Cahill, Ina Conner Campbell.

¹ New members not listed in this issue due to lack of space will be listed next month.

The New Books

Children of the Mutineers—Life of the Seas—Jennings’ “Genetics”—Books on the Stars

THE HERITAGE OF THE BOUNTY. By Harry L. Shapiro. Simon and Schuster, New York. \$3.00.

ARCTIC ADVENTURE. By Peter Freuchen. Farrar and Rinehart, New York. \$3.50.

WE EUROPEANS. By Julian S. Huxley and A. C. Haddon, with a Contribution by A. M. Carr-Saunders. Harper and Brothers, New York. \$2.50.

DISEASE AND DESTINY. By Ralph H. Major, M. D. D. Appleton-Century Co., New York. \$3.50.

AS THE “Zaca” neared Pitcairn, Doctor Shapiro was terrified lest this “shadow of an island” might fail to equal the image he had treasured for twelve years. He had long been preparing himself for the opportunity to study at first hand this unique blending of English and Polynesian blood and culture. Back in 1923 he almost got to Pitcairn, but found himself obliged to choose a five-months’ stay on Norfolk Island instead. There he was able to study the numerous descendants of the Bounty mutineers now living in Norfolk.

Doctor Shapiro’s successful trip to Pitcairn was made with the Templeton Crocker 1934-35 Expedition, which was described by Dr. James P. Chapin in *NATURAL HISTORY* for November, 1935, and April, 1936. *The Heritage of the Bounty* includes a short history of the Pitcairn Islanders from the first settlement by nine fugitive mutineers, with the Tahitian women they had taken as wives, and the six native men they carried along as servants. Doctor Shapiro makes the astounding story of how a psalm singing and humbly industrious population arose from a heritage of lust and murder as clear as the conflicting early documents permit. He is favorably impressed by the biological results of this unpremeditated experiment in hybridization, isolation, and inbreeding. The islanders seem in no way degenerate and the only noteworthy defect of any kind shown by any large number of these people was the almost universal loss of teeth, which “had produced a curious sucking-in of the cheeks and a collapse of the mouth.” Several of them reminded Doctor Shapiro of the bird man in Barnum and Bailey’s, with their thin prominent noses and atrophied jaws. Fortunately, a dentist has recently settled temporarily among them.

The islanders who eagerly boarded the “Zaca” looked more like English dock workers than the Polynesians of romance. But after living and working with them Doctor Shapiro came to feel friendship and something of admiration for these most interesting hybrids.

Pitcairn, a rocky-shored island, some two miles long, had no inhabitants when the mutineers and their followers landed there in 1790. In 1808 after a series of murders and battles among the few inhabitants (including revolts by the women) there were left “one surviving mutineer, eight or nine Tahitian women, and twenty-five children. These last were the progeny of the Englishmen and their Tahitian wives, the native men having left no offspring.” As Doctor Shapiro points out, the islanders were already showing the orderly characteristics for which they later became famous, “Morning and evening family prayers were made a regular practice and services were held on the Sabbath.”

Morality and a prodigious increase in the population apparently were correlated in the subsequent history of Pitcairn. As Doctor Shapiro says, “Vital statistics are the bookkeeping of a nation. They reveal the present state of affairs, uncover past trends, and cast up a balance, favorable or otherwise.” From 1808 to 1856, the inhabitants increased from thirty-five souls to 193, or over 550 per cent. In 1856, fearing that the resources of their small island would no longer support them, the colony moved *en masse* to Norfolk Island. By 1864 about forty-five of the emigrants had returned to Pitcairn and it is from the voyagers who returned that the present population of over 200 is derived.

The Heritage of the Bounty is an excellent account of the history and present status of the people of Pitcairn, presenting its scientific conclusions in a thoroughly digested and entertaining form. Doctor Shapiro’s style is clear and direct and admirably conveys the flavor of this microcosm of Anglo-Polynesia.

The Great Dane of Greenland

Peter Freuchen’s contribution to anthropology is not based on the friendly objectivity of the scientist; he gained his knowledge of Eskimos by living with them, by eating their stinking food, by enduring their hardships (once cutting off his own toes with a nail puller and a hammer when his foot was

gangrened), and by marrying an Eskimo woman and raising two children. His life with her was an exceedingly happy one and it was not until her death and the crippling of his feet that he began to feel that Greenland was becoming impossible for him.

Since coming to this country Freuchen has written two popular books and has savored the delights of Hollywood; it would be interesting to know if he has conditioned himself to his present environment as happily as he did to such an utterly different one during his fifteen years in Greenland and northern Canada. He went to Greenland first in 1907, because he feared boredom in his native Denmark; he really wanted to work hard, to fight the elements for a bare living in a country where both much labor and good fortune are necessary to secure seal meat and skins. But he was fortunate in his companions. From his, as well as from other contemporary accounts of the Eskimos, the stay-at-home reader gathers the impression that if one were obliged to live in Greenland the Eskimos would certainly be the best companions to live with.

Freuchen relates a good many incidents that could hardly be retold in a family magazine, of which the Eskimos' custom of lending their wives to friendly visitors, is perhaps the least disconcerting. But his book leaves a final impression of being the adventure of a fine and understanding soul among a people admirable for their humor and their kindness.

We Europeans

The approach taken by Messrs. Huxley and Haddon in *We Europeans* is indicated by the subtitle, *A Survey of "Racial" Problems*, in which they put the word which is the focus of so much and such bitter argument in quotation marks. They are convinced that:

"No single scheme of classification can satisfactorily pigeon-hole all known human types, or even deduce without error the number and characteristics of the original 'primary' races of man. Whereas in the evolution of animals, there is a constant branching, each branch being isolated after a certain degree of differentiation by becoming incapable of fertile crossing with other branches, in man the branches constantly meet and unite and produce new types of shoots."

Hence, Huxley and Haddon think that the terms "race" and "sub-species" as applied to existing human groups have no significance. On the Nordic question, they admit that separate types can be distinguished within the white "ethnic group" (to use the phrase they favor), such as the tall fair Nordic, the round-headed Eurasian (often called Alpine) and the short, darker, long-headed Mediterranean. But they believe that there is no concrete evidence to show that "these hypothetical stocks once existed in a state of complete or almost complete purity." They think that six or seven thousand years ago blond and dark hair, tall and short stature, brachycephaly and dolichocephaly, were already widely distributed among the tribes of Europe. However, they admit that the present distribution of the Nordic type in Europe can be ascribed with reasonable certainty to invasion by a group composed largely of "men of this type—

perhaps in the degree in which the type is now found in parts of Scandinavia."

But while Huxley and Haddon admit the existence of the type they are extremely sceptical as to its exclusive possession of qualities that fit it to rule over other types.

Following Hrdlička, Huxley and Haddon think that the Nordic element in the "Old Americans" is small. They point out that observers get very different impressions of a people at different periods: where foreigners were once struck by the prevalence of tall lantern-jawed individuals in the United States they are now impressed by "the prevalence of square-faced stocky business men." As to national character:

"There was a time when England was called 'merry'; during the nineteenth century that epithet was not applicable. In Elizabethan times the English were among the most musical of the European nations; the reverse is generally held to have been true in late Victorian times . . . In Carlyle's time, the German national character was supposed to be peaceable, philosophic, musical and individualist. After the Franco-Prussian war it became arrogant and militarist. Now we are witnessing the blossoming of tendencies to state-worship, mass-enthusiasm and the like."

Perhaps the most interesting chapter of this book is the one on "The Principles of Heredity as Applied to Man" which contains an incisive discussion of Mendelism and the gene-mechanism of heredity and such new light as they cast on human problems.

Did Nietzsche Cause the War?

Disease and Destiny traces the influence malaria, smallpox, the Black Death (bubonic plague according to Doctor Major), and other diseases have had on the human race and its great men. The subject is a fascinating one; Doctor Major has collected many entertaining facts, and he reminds us effectively that malaria probably had a good deal to do with the decline of Greco-Roman civilization and that the plague in Athens may have damaged that city as much as the Peloponnesian War.

Unfortunately, Doctor Major is still toying twenty-two years after 1914 with such questions as "Did a paretic [Nietzsche] cause the World War?" He thinks that, through Nietzsche, "the French disease [syphilis] has changed the course of human thought just as it may have played a leading rôle in precipitating the recent catastrophe." Such weird opinions as this make one doubt the validity of his other conclusions.

—GORDON LAWRENCE.

A NATURAL HISTORY OF THE SEAS. By E. G. Boulenger. D. Appleton-Century Co., New York.

POPULAR interest in all matters pertaining to the life of the seas has been so universally aroused in recent years that there has been a great demand for books on the subject adapted to the general reading public. This new book by Dr. Boulenger is eminently adapted to fill a definite need in this connection. It is a concise review of the animal life in the seas, moving rapidly from the simplest forms of animals through the great invertebrate phyla and concluding with chapters on the fishes, sea reptiles and mammals. Finally, there is even a chapter on the legends regarding sea monsters.

Many striking forms of life are dealt with in the book, and curious partnerships between widely different species are described, such as, for example, the hermit crabs that carry stinging sea anemones on their backs for protection while they themselves furnish transportation and tear food apart to share it with their partners; giant jellyfish which shelter young horse mackerel; and Portuguese men-o'-war which protect certain fish from their enemies. Crabs, shrimps, sea stars and sea urchins are dealt with in turn, while many diverse strange and beautiful species of sea worms add to the picturesque-ness of the fauna described.

In a chapter on mollusks, the author reviews, in brief but interesting manner, the most striking of the sea snails, not only along our own coasts but those found in other seas, from the common periwinkle of the Atlantic coast and the polished cowries of eastern seas with their beautifully patterned shells, to the violet snails which build rafts of air bubbles and swim on the ocean surface. The voracious whelks are described that bore holes in other mollusks to suck out their soft contents. The bivalve mollusks are briefly described, from common oyster to giant clam, and several pages are devoted to description of squids and octopuses.

Descriptions of a remarkable diversity of fishes are packed within a few pages and pictured most vividly, from the familiar food fishes to the odd and grotesque creatures of the deep seas. In another chapter, sea turtles, marine lizards and the poisonous sea snake are mentioned, while manatees, seals, walruses and whales are not neglected.

The book contains somewhat over two hundred pages of text, and is filled with striking figures and photographs. As a whole, it forms a useful and popularly worded introduction to the life of the seas.—ROY W. MINER.

GENETICS. By H. S. Jennings. *W. W. Norton & Co.* 372 pages. \$4.00.

NO FIELD of modern biology has advanced more rapidly than that of genetics. Numerous journals devoted entirely to this field of research have sprung up in many parts of the world. America has from the very beginning taken the lead in this study. Although numerous text-books in English and foreign languages have appeared from time to time, few of the popular accounts which have appeared have been at all comprehensive.

Prof. H. S. Jennings, Director of the Zoological Laboratory of Johns Hopkins University, has been a leader in the field of experimental biology throughout the period that genetics has made its most important strides. In reviewing this field he has brought to bear a considerable amount of critical judgment, while at the same time he has avoided mere technical terms, with a view to making his book attractive to the intelligent layman.

The recent work on the effect of high temperatures, X-rays, radium, and various other physical agents on the hereditary mechanism are fully described. This includes the recent studies of Jollos, Muller, Goldschmidt, Plough, Demerec, Horlacher,

Johnston and others. The work of Stockard on the relation of endocrines to genetics in the evolution of the dog tribe with its possible bearing on human evolution is also discussed. There is a chapter on the constitution of the chromosomes and genes. The latter are no longer theoretical units of heredity. Several workers have claimed to have seen genes. Professor Jennings fully discusses this phase of the problem. There are other chapters which give the reader a clear view of the laws of inheritance and the action of genes during development. The recent discoveries as to the nature of sex both from the genetic and from the endocrine aspect are described, including the latest views on the relation of the autosomes to the sex chromosomes. The rôle of the environment in evolutionary change is also fully considered from the various aspects. *Genetics* is a book which all students of nature will find both comprehensive and inspiring.—G. K. N.

CONSIDER THE HEAVENS. By Forest Ray Moulton. *Doubleday, Doran & Co., Garden City.* \$3.50.

DOCTOR MOULTON is one of the world's leading authorities in astronomy, and especially in the field of celestial mechanics; he is co-author (with Chamberlin) of the Planetesimal hypothesis of the origin of the solar system. His new book is not just another book on astronomy; but it is definitely one of the outstanding recent works on the subject.

The book is intended to give a good picture of the stars and universe, and an idea of the methods of scientific thought, by which the astronomer arrives at his data. It is very pleasing to read, but not too easy by any means; to grasp the full significance without a careful reading would be difficult. Yet this book is very highly recommended by the reviewer because of its authority, the amount of data, the incomparable way in which the story is told, and the point of view of the author.

The first chapters give some history and a good idea of order prevailing in the seeming complexity of celestial motion. The Sun and all his family of planets are described in an absorbing way and there is a long chapter on their origin. Life on other worlds has a good chapter. Moulton says:

"If we could go to Mars! . . . vague visions . . . of rocket cars capable of making journeys through interplanetary space . . . there is not in sight any source of energy . . . to get us beyond the gravitative control of the earth . . . there is no theory that would guide us through interplanetary space to another world . . . no means of carrying the large amount of oxygen, water, and food . . . no known way of easing our ether ship down. . . ."

The last half takes up stars, nebulae, stellar systems, and galaxies. Taking an illustration from geology the author compares the study of paleontology to that of the stellar systems:

". . . Hutton and Lyell . . . read in the records of the rocks geological history extending back over millions of years . . . the dynamical records writ-

ten in the regularities of the globular clusters are expressed in characters which are fully as intelligible and as certain as the records in the rocks, and they cover periods perhaps a million times as long as the entire history of our earth."—HUGH S. RICE.

WORLDS WITHOUT END. By H. Spencer Jones. The Macmillan Company, New York.

THIS is a popular astronomy book—an introduction to the study of Astronomy—by that learned and distinguished man of science, H. Spencer Jones, the Astronomer Royal of Great Britain. That this book is scientifically accurate goes without saying—and this alone would make it a valuable addition to modern popular astronomical literature. That it should be such an eminently readable book as it is, a book which communicates so easily and so conversationally, the high spots of astronomical knowledge, is a matter for even greater rejoicing. There is here no text-book atmosphere, no condescending of the teacher to the taught. One sits down comfortably in the study of this wise astronomer and listens to his simply delivered words. And the picture of the universe here presented is a clear, an understandable one, insofar as it is understandable to any man. The earth, the solar system, the stars, the galaxies,—a review of past history and future possibilities,—all are presented here with no dogmatism, with no prejudices, but with the sanest judgment and a profound understanding of the limitations of our knowledge. The chapter called "Life in Other Worlds," for instance, could serve as a model of this kind of writing, presenting the facts clearly, so far as we know them, and leaving the reader himself to wander about as he pleases among the possibilities. The reader who can look beyond the surface simplicity of this book recognizes the vast amount of erudition and experience which have gone into the presentation of this material. Dr. Spencer Jones seems to be not only a great scientist but an unusual teacher.

The illustrations are excellent, culled from here and there among the world's great observatories. —MARIAN LOCKWOOD.

THE MUSHROOM HANDBOOK. By Louis C. C. Krieger. The Macmillan Co., New York. \$3.50.

AN ILLUSTRATED MANUAL OF PACIFIC COAST TREES. By Howard E. McMinn and Evelyn Maino. University of California Press. \$3.50.

HERE are two excellent manuals, both beautifully illustrated, and of convenient size for carrying in the field.


The *Mushroom Handbook* is impressively complete. It contains thirty-two color plates, from paintings by the author and more than a hundred black and white drawings and photographs. Mr. Krieger tells which varieties are safe to eat and which are poisonous, giving the amateur about as sure a guide as he is ever likely to find (although some of us amateurs would decline to eat any mushroom we had gathered in the field, even after

comparing it with all the handbooks). His account of the history and general characteristics of mushrooms is clear and concise; he tells in an interesting manner where they grow (and how to grow the cultivated species), their economic importance, seasonal occurrence, and the distinguishing characteristics of various species. He includes an appetizing array of recipes for cooking mushrooms.

An Illustrated Manual of Pacific Coast Trees is a thorough guide to the woody plants of one of the most interesting floras in the world. The dominance of the conifers, the pines, spruces, redwoods and their relatives in one of the richest forest regions is the more impressive, considering that similarly favorable locations in most parts of the world tend to be occupied by broad-leaved trees. Professor McMinn lists 59 species and varieties of native conifers against eighty-four ordinary broad-leaved trees, two arborescent yuccas and one palm. In our part of the world, in the whole vast area from Newfoundland to the southern boundary of Virginia and from the Atlantic west to the 102nd meridian, Britton and Brown list only twenty-eight native conifers.—G. L.

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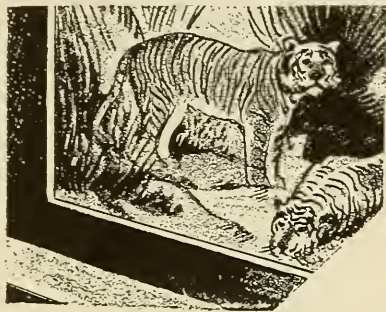
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VOLUME XXXVIII

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MASON

THE ARCHER FISH IN ACTION

Fantastic creatures usually lose their incredible attributes in the light of science. Here is one, long doubted by scientists, that becomes more remarkable the more we learn of it. In the accompanying article Doctor Smith narrates

his personal experiences with the "blow-pipe" fish, and explains for the first time the apparatus which enables this strange fish to "shoot" its food

The Archer Fish

It secures its food by shooting insects with a pellet of water, and almost never misses its target at four feet

By HUGH M. SMITH

*Formerly Fisheries Advisor
to the Kingdom of Siam.*

WHEN I went to Siam to study the remarkable fish life of the fresh and salt waters, one of the things I was most anxious to do was to make the intimate acquaintance of the archer fish, a creature which gets its living by a unique practice which had never been satisfactorily explained by scientists.

In the eighteenth century and earlier, vague accounts reached Europe regarding an oriental fish which obtained its food, consisting of insects, by knocking them down with drops of water propelled from its mouth. These accounts, unsupported by reliable evidence, doubtless met with a mixed reception on the part of zoölogists and the general public; and it may be imagined that the scientific world of that day was eager to obtain authentic information concerning a creature whose behavior was so different from that of any other known fish.

The earliest record

The first definite printed reference to the fish in a European language seems to have been published in the year 1765, in the *Philosophical Transactions of the Royal Society of London*. At a meeting of the society held on March 15, 1764, a communication* was read from John Albert Schlosser, M.D., F.R.S.,

of Amsterdam, announcing the presentation to the society of a specimen of the fish which, to quote him, "I believe hath never been observed by any writer on natural history." The communication carried a description of the peculiar habits of the fish on the authority of a Mr. Hommel, governor of a hospital in Batavia, who was also the collector of the specimen. Designated as "the jaculator or shooting fish, a name alluding to its nature," the creature was described as follows:

It frequents the shores and sides of the sea and rivers, in search of food. When it spies a fly sitting on the plants, that grow in shallow water, it swims on to the distance of four, five or six feet, and then, with surprising dexterity, it ejects out of its tubular mouth a single drop of water, which never fails striking the fly into the sea, where it soon becomes its prey. The relation of this uncommon action of this cunning fish raised the governor's curiosity; though it came well attested, yet he was determined, if possible, to be convinced of the truth, by ocular demonstration. For that purpose, he ordered a large, wide tun to be filled with seawater; then had some of these caught, and put into it, which was changed every other day. In a while, they seemed reconciled to their confinement; then he determined to try the experiment. A slender stick, with a fly pinned on at its end, was placed in such a direction, on the side of the vessel, as the fish could strike it. It was with inexpressible delight, that he daily saw these fish exercising their skill in shooting at the fly with amazing dexterity, and never missed the mark.†

†Unfortunately for the accuracy of the record, the fish to which Hommel referred and the specimen which he sent to London were entirely different species. Appended to the article was a copy of a description given in 1754 by Linnaeus of a species called *Chaetodon rostratus* (known in later years as *Chelmo rostratus*), and the accompanying plate was of that fish of the coral reefs. There were thus precipitated the misunderstanding and doubt concerning this fish which lasted for nearly a century and a half.

*"An Account of a Fish from Batavia, called Jaculator." *Philosophical Transactions*, Vol. LV, for the year 1764, p. 89-91, plate 9.

IMPORTANT NOTICE TO MEMBERS

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A second article on this fish,* also contributed by Doctor Schlosser, contained a description of the fish in Mr. Hommel's own words and gave additional information on the fish's peculiar habits.

Shooting powers denied

During practically the whole of the nineteenth century there seem to have been no new observations on the shooting powers attributed to the archer fish and no confirmation of the statements made by Hommel in 1765 and 1767. On the contrary, the leading authorities on oriental fishes denied that the fish did or could perform as claimed.

Dr. Pieter Bleeker, "the most active ichthyologist that ever lived," who spent more than thirty-five years studying the fishes of the orient, was author of more than four hundred articles on those fishes, and was long a resident of the same city (Batavia) as Hommel, was unable to verify the early accounts of the jaculator fish and in 1875 expressed the belief that it did not deserve the celebrity which had been imposed on it and that its reputation was based on an error of observation.

Dr. Francis Day, who devoted more than a quarter of a century to the investigation of the fishes of India and Burma and published monumental works thereon, withheld from *Toxotes* any credit whatever for its extraordinary shooting ability and erroneously ascribed to the coral-reef fish *Chelmo* the same ability. Thus, in "The Fauna of British India—Fishes" (1889), Day disposed of *Toxotes* in these words:

It is stated in some works that these wide-mouthed fishes shoot insects with a drop of water in Batavia. Bleeker observed that he never witnessed this, and the action is one which the mouths of these fishes appear incapable of effecting.

In an earlier article,† "On Asiatic Blowpipe Fishes," Day argued that Hommel's account could not have applied to *Toxotes* and could only have referred to *Chelmo*. He claimed

that "no one, that I can ascertain, has asserted that *Toxotes jaculator*, with its deeply cleft mouth, was able to use it as a blowpipe," and said further that "personally I paid special attention to this question when investigating the fishes of Burma, but no fisherman had ever heard of this ingenuity being attributed to *Toxotes*, and which I cannot help thinking, with the late Doctor Bleeker, must be an error."

The original source of misunderstanding, as disclosed by the articles in the *Philosophical Transactions* and the perpetuation of the error by Bleeker, Day, and others, was undoubtedly due in some measure to the fact that among the Malays both *Toxotes* and *Chelmo* are called by the same name, *sumpit-sumpit* (from *sumpitan*, a blowpipe).

One more quotation from a reputable source may be given to illustrate the attitude of mind toward the most characteristic habit attributed to the archer fish; this is from a notice of *Toxotes* by the late Professor J. S. Kingsley appearing in the *Standard Natural History* (Vol. 3, 1885):

One of the species has been generally credited with the faculty of shooting drops of water at insects on low-hanging branches and thus securing them for food. There does not appear to be any adaptation in the organization of the mouth for such a feat, and skepticism must be exercised in the acceptance of the statement made. Certainly no recent confirmation of the old story has been given, and the tradition has probably resulted from some misunderstanding.

The fish comes into its own

Although several minor notices of the habits of *Toxotes* appeared in European periodicals in the last two or three years of the nineteenth century, it was not until the twentieth century had dawned that this fish may be said to have finally come into its own. The observations of a Russian ichthyologist, Zolotnisky, on the fish in captivity definitely corroborated the essential facts of behavior as set forth in the earliest published accounts.‡ A number of living specimens had been obtained in Singapore, and these were subjected to close scrutiny and experimentation, with the result that not only were the long-disputed habits fully established, but new items of behavior were noted and set forth.

*"Some further Intelligence relating to the Jaculator Fish." *Transactions of the Philosophical Society*, Vol. LVI, for the year 1766, p. 186-188, plate 8, fig. 6. Doctor Schlosser this time presented another specimen, and a description of it under the name *Sciaena jaculatrix* was given by the German zoologist Pallas. A poor but easily recognizable illustration accompanied the article. The allocation of the species with the sciaenid fishes, or drums, was unfortunate, as there is not even a remote relationship; and in 1817 Cuvier corrected the error and established the genus *Toxotes* for the reception of the fish which has since been known as *Toxotes jaculator*. This form and five closely related species constitute the family Toxotidae, peculiar to the oriental region.

†*Zoölogist*, 1881, p. 91.

‡Zolotnisky's detailed report, "Le Poisson Archer (*Toxotes jaculator*) en Aquarium" was issued in 1902 in *Archives de Zoologie Experimentale et Generale*. Vol. X, p. lxxiv—lxxxiv.

Among the facts regarding *Toxotes* which were recorded by Zolotnisky and have been confirmed by the present writer and other persons in Asia and America were the following:

(1) The fish subsists largely on insects which hover over the water or rest on overhanging vegetation. When a fish approaches within a certain distance of an insect, it becomes stationary, points its head and turns its eyes directly at the prey, brings the front of its mouth to the surface of the water, partly opens the mouth, and forthwith propels a drop, or several drops, of water at the insect, which ordinarily is 12 to 20 inches distant, but may be 40 inches or more. The aim is true and the insect falls into the water and is at once devoured.

(2) The fish frequently swims backward. This habit is often observed when the fish reconnoiters a prospective prey, and backs from it in order to secure a good position for observation and attack.

(3) The eyes sparkle with seeming intelligence and their mobility is noteworthy. They can be directed laterally, upward, and backward, but may not be turned downward.

(4) Aerial vision is acute. Even small insects may be seen at a great distance and fall a prey to the fish's amazingly accurate aim.

(5) Discrimination and selection are apparently exercised in the choice of food; considerable ingenuity is sometimes employed in obtaining food; and in shooting at insects the distance and the force are gauged.

Doubt

Zolotnisky's paper was made the basis for a critical review of "The Archer Fish and Its Feats" by the erudite Dr. Theodore Gill, published by the Smithsonian Institution in 1909*; and the foregoing statement of Zolotnisky's observations is largely a paraphrase of Gill's rendering. Gill found it difficult to accept some of Zolotnisky's statements and in concluding his paper said:

This summary is a true version of the article by Zolotnisky and will doubtless excite skepticism among physiologists at large as well as psychologists. It contravenes certain assumptions respecting the power and range of vision among fishes, as well as of the intelligence and reasoning powers of such lowly animals. The extent of expression assigned to eyes destitute of mobile surroundings and accom-

modative adjustments may also be deemed to be exaggerated. Distinction therefore must be exercised between the facts observed (or alleged to have been observed) and the inferences respecting such facts. It must be conceded, however, that fishes which manifest such peculiar action as the archers should be subjects for still more elaborate observations and experiments.

In recent years in America many people have become acquainted with the archer fish and its performances through examples in aquaria in New York, Philadelphia, and other cities; and a motion picture of a fish in action has been made at the New York Aquarium. The present generation of fish students everywhere may be pardoned for expressing surprise at the protracted skepticism, and wonder at the failure of doubting oriental ichthyologists to conduct practical tests.

How Toxotes shoots

One searches the literature in vain for an explanation or suggestion as to how an archer fish is able to propel a drop of water with such force and accuracy that it can dislodge insects on overhanging vegetation or hit them on the wing.

The doubt shown by zoölogists of the last century in regard to the reputed shooting powers of the fish was partly due to their failure to detect in the fish's mouth any special mechanism by which drops of water could be formed and expelled.

It is, of course, obvious that there must be some peculiar adaptation or apparatus in *Toxotes* to account for its extraordinary accomplishment. Let this be the occasion to point out, for the first time, the special anatomical and physiological features on which the shooting performance depends.

By carefully watching the fish at close range on many occasions in Siam, I formed an opinion of the probable propelling mechanism, and I subsequently verified that opinion by holding the fish in a basin or bucket of water in the position regularly assumed when shooting and making them perform almost at will. This was accomplished by the quick, forceful compression of the gill covers with my fingers. I was able to cause a fairly satisfactory imitation of the normal shooting act, and had no difficulty in propelling drops of water for distances up to three feet.

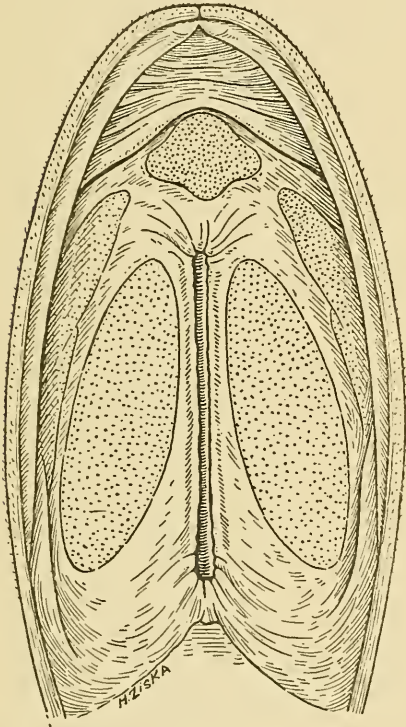
This compression of the gill covers would in itself not be adequate to account for the

**Smithsonian Miscellaneous Collections*, vol. 52, part 3, p. 277-286.

escape from the mouth of water in the form of individual drops of uniform size; and it is to the peculiar shape and structure of the mouth parts that we must look for the additional factors necessary for the complete and perfect performance.

The mouth cavity of *Toxotes* is long but its diameter is much restricted by the projecting sides of the roof and by the large tongue which when raised may completely close the passage from the outer air to the pharynx. The anterior part of the tongue is free from

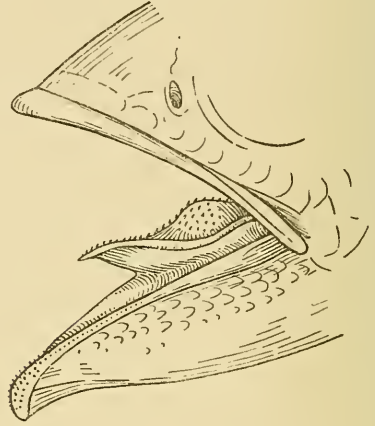
pharynx, are two low ridges, close together and parallel for most of their length, but slightly diverging at their posterior ends. Between the ridges is a deep groove which, when the tongue is applied to the roof of the mouth, becomes converted into a tube. This groove-tube, which in a fish seven inches long is less



"BLOW-PIPE" OF ARCHER FISH

The groove-tube which enables the archer fish to project pellets of water from its mouth: a narrow slot in the roof of the mouth which is closed by the tongue

the floor of the mouth, and its rounded tip is of paper-like thinness and fits snugly against the palate; posteriorly the tongue is thick, bears minute teeth, and has a conspicuous fleshy prominence. Extending along the median line of the roof of the mouth, from a point just behind a band of vomerine teeth to the



When the odd shaped tongue fits against the roof of the mouth a slender tube is formed, which is less than a sixteenth of an inch in diameter in a fish that is seven inches long

than a sixteenth of an inch in diameter, has not been previously described or referred to in ichthyological writings, but is readily seen when the tongue is depressed. That it should have been so long overlooked is something of a mystery when one recalls the vain efforts made by oriental ichthyologists to discover any special adaptation for drop-shooting.

We are now ready to appreciate how the shooting fish operates. With the tongue closely pressed against the palate, the sudden compression of the gill covers will force water from the pharynx into the palatine canal; and with the tip of the tongue acting as a valve, the flow of water under pressure from the anterior end of the tube is regulated. It is the obvious habit of the fish to coördinate the compression of the gill covers with the momentary lifting of the tongue from the anterior end of the tube, permitting the escape of a single drop of water. With the jaws partly separated and the mouth reaching or projecting slightly above the surface, the drop of water is ejected with a force and for a distance that depend on the pressure. It is easy to understand how, with

the pharyngeal cavity serving as both a reservoir for water ammunition and a compression chamber, it is possible for the fish to shoot drops of water in quick succession, as has been frequently observed, or the water may be expelled in the form of a jet when the valve is kept open longer.

Vision

The drop-propelling function would be useless if *Toxotes* did not possess, in addition, the ability to use its eyes in the air and to gauge accurately the distance, size, and suitability for food of small creatures flying or resting near the water's edge. It is an outstanding point that, for a fish, the aerial vision of *Toxotes* is very keen; and it was always a surprise to me to note the readiness with which insects and spiders were sighted as the fish explored the vegetation on the bank of a pond or stream.

The extent to which the fish's head projects at the surface of the water during the shooting act depends on circumstances. In muddy water the eyes must be at the surface in order to permit a good view and accurate aim; in clear water only the tip of jaws need project.

The chief accomplishment of the archer fish has been developed and is exercised in order to obtain living food consisting chiefly of insects. Enough has already been stated in regard to the general habit, but some definite references to food and feeding may be of interest.

This fish, with shapely, compressed body propelled by its broad caudal fin, is a graceful swimmer, moving quickly without apparent effort. It regularly swims at or just below the surface, and may go a long distance in a perfectly straight line, making a wake with the tip of its jaws. This wake is characteristic and enables an observer to detect the presence of a fish even before he has actually seen it.

The habit of swimming at the surface is ascribable to two circumstances: the food on which the fish chiefly subsists is obtainable there, and the eyes, on which the fish largely depends, could not otherwise function properly, for during most of the year the waters in which *Toxotes* lives are very muddy or turbid and aquatic vision is much restricted.

While *Toxotes* prefers the live food which it shoots for itself, it regularly eats shrimps, insect larvæ, and other creatures living in the

water and insects that have fallen into the water. A large nest of carpenter ants impaled on a stake in a pond provided food for fish for several days as the ants fell into the water and were eagerly devoured. Under both semi-domesticated and wild conditions the fish does not reject bits of raw and cooked meat, fish, crabs and prawns; specimens which I had in a pond regularly came to be fed on raw chopped pork and fish.

In Siam, *Toxotes* is often sought by anglers, who use a light rod and line, armed with a small hook baited with a shrimp or insect. Favorite resorts for the fish—and hence for anglers—are the inlets and outlets of canals, near locks. A person in a small boat, casting his hook well away from the boat and doing nothing to frighten the fish, may often catch many at one place. The food value of the fish is high.

Toxotes versus a lizard

Once, in Bangkok, I saw a baby lizard, sunning itself on a vertical timber of a dock a few inches above the water, dislodged by a surprise shot of a *Toxotes* operating at point-blank range. As the lizard fell it was promptly grasped, but there may be doubt whether it was actually consumed. The cavity of this fish's mouth is too narrow and the sides are too rigid to permit the passage of a large mass of food; and it is apparent that seized insects and other food must first be reduced to a slender bolus between the tongue and the various bands of minute teeth on the roof of the mouth before swallowing is possible.

Some of the standard modern works of reference and text-books make inadequate or misleading allusion to the exercise of the shooting power. Thus, when the *Cambridge Natural History* states that "*Toxotes jaculator* derives its name from its habit of capturing insects flying over the surface of the water by shooting drops of water at them," it overlooks the much more common and characteristic habit of stalking insects that are resting on plants in the water or at the water's edge. In reality, insects shot on the wing represent a very small percentage of the total food intake. In Siam, *Toxotes* was very rarely noticed in pursuit of flying insects. On the few occasions when I observed this habit there had been an irruption of winged termites and the fish were very active in chasing the low-flying insects across

a pond or water-course and directing a perfect barrage of shots if necessary to bring down the prey.

In "The Biology of Fishes" (1926), the author, H. M. Kyle, observed that "the taste for flies has become so great that one fish has developed into an expert sharp-shooter in stalking and smothering flies—with a drop of water and mucus." If "flies" can be interpreted as including ants, bees, termites, grasshoppers, moths, caterpillars, dragon-flies, beetles, cockroaches, ephemerids and many other kinds of insects, as well as spiders, the statement is correct with the exception that insects are not smothered and there is no mucus in the watery pellet.

Marksmanship

The range, accuracy, and force of the shooting powers of *Toxotes* always excite surprise and admiration. In my experience in Siam the distance within which the fish could always be depended on to score a direct hit was three and a half to four feet. A much longer effective range has been recorded. Two fishes in the New York Aquarium could without difficulty hit a small cockroach at a measured height of five feet above the water.

Failure to hit a resting insect within proper range may be due to movements of the vegetation or, in the case of a spider dangling on a thread, to swaying caused by wind. When the first shot misses a mark, other shots usually follow in quick succession.

The force with which the watery pellets may strike an object is sometimes most astonishing to a human observer. An insect may be knocked high in the air or may fall on the bank beyond a fish's reach. At short range the drops may strike a person's face with a distinctly stinging sensation. On many occasions, during exhibitions in Siam, a spider at the end of a thread hanging from the end of a pole was knocked far up on the thread or even over the pole. Spent shots could be heard to splash against the roof of a veranda over the water.

The shooting habit begins to develop early and may be observed in fish only an inch long. It is most amusing to see the inexperienced youngsters emulating the actions of their parents and sending out tiny drops which may go only two or three inches. In half-grown fish the habit is well developed, but the highest

expression of the shooting powers as regards accuracy, force, and range is to be seen only in the fully matured fish.

A peculiar feeding trait was exhibited by both river fish and pond fish in Siam when a spider on a thread was lowered to within about one foot of the surface of the water. A fish, which may have been shooting at the spider when it was two or three feet distant, would with little apparent effort rise vertically from the water and seize the lure in its mouth, sometimes holding on when the line was raised several feet. This was done so readily and regularly as to suggest a normal habit, although as a matter of fact I never saw it tried on insects hovering near the surface or resting on plants. Probably spiders and caterpillars hanging from their threads are the principal victims of this method of attack.

The writer's acquaintance with this fish was formed in the Philippines, French Indochina, Siam, Malaya, Burma, and India, but chiefly in Siam where it is common over most of the country and is called *pla sua*, or tiger fish, in allusion to the black crossbands on the yellow sides. Wild fish planted in a large pond in the compound of my residence in Bangkok were under close observation for a number of years, and were a source of pleasure and instruction to myself and many foreign visitors and residents.

Intelligence

Among all the oriental fresh-water fishes with which I am acquainted in the wild state, none gives such an impression of intelligence and efficiency as does *Toxotes*. This impression grows on an observer as he notes the purposeful way in which a fish moves about in a stream, canal, or pond; the zeal and thoroughness with which it explores aquatic and overhanging land plants for insects; the high development of its sense of sight in both air and water; the skill displayed in dislodging insects and seizing them as they fall into the water; the alertness in avoiding danger; and the readiness in adapting itself to life in small ponds and responding to the attentions of persons who provide food.

For the amusement of guests

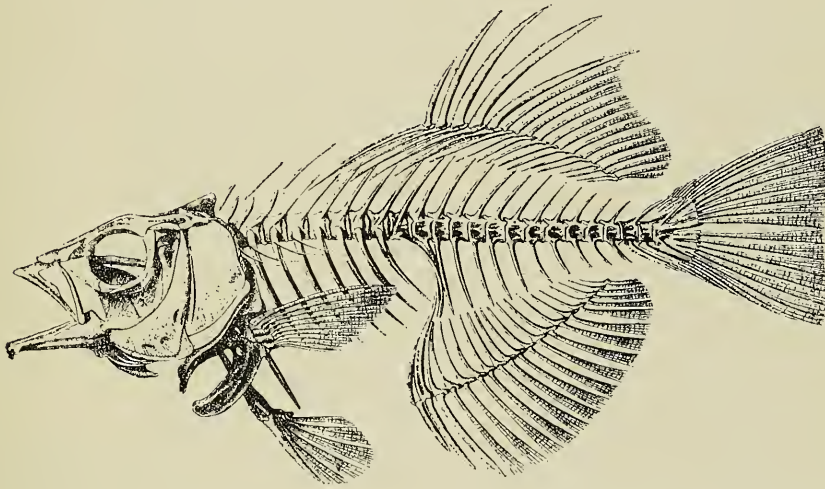
A friend of mine, a distinguished scion of the royal family of Siam, and an ardent student of fishes, had a residence on the broad

Menam Chao Phya above Bangkok and used to entertain American and European guests with shooting-fish performances. A veranda on which he took many of his meals was directly over the water, and under it *Toxotes* could be found almost daily, attracted by scraps of fish, meat, chicken, and prawn which were regularly thrown from the table. By means of a spider or cricket dangled on a black thread from the end of a short bamboo pole, the shooting fish could readily be induced to display their marksmanship, and scores of foreign visitors, during the years I passed in Siam, were thus edified and amused. It was

there that I sometimes saw spent watery pellets splash on the ceiling of the veranda ten to twelve feet above the river, and witnessed many other exhibitions which confirmed my respect for the intelligence and skill of *Toxotes*.

Carrying it too far

On two occasions to my personal knowledge, when my friend sat on the veranda eating his breakfast, reading a newspaper, smoking a cigaret, and apparently neglectful of his fish wards, his attention was attracted by well-directed shots which extinguished his cigaret.



Skeleton of Archer Fish (After Agassiz)

The Archer Fish

*This curious fish makes its living by shooting insects with a drop or a short jet of water. Its aim is extremely accurate up to five feet, and if the drops strike one in the face at short range they produce a distinct stinging sensation. Shots that go wild carry ten to twelve feet. When maneuvering for a good position from which to "open fire," the fish frequently swims backwards; and its eyes, which are movable, sparkle with seeming intelligence. (It cannot definitely be stated that the specimen shown in these photographs is *Toxotes jaculator*, the species commonly referred to.)*



New York Aquarium, Dunton Photo

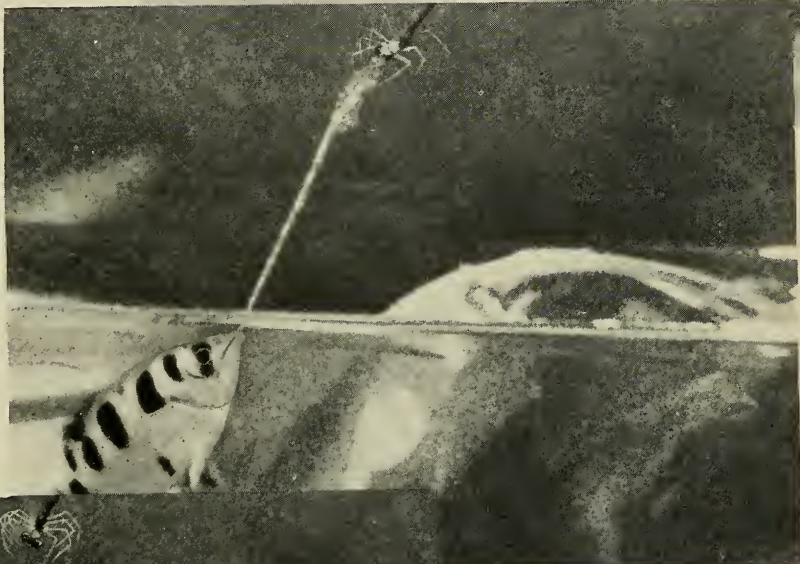
(Below) The archer fish preparing to shoot a spider



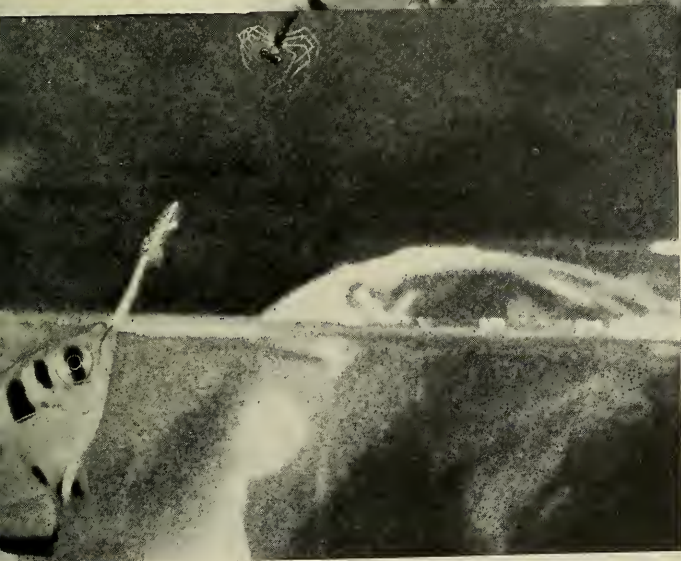
If the archer fish cannot get its prey in any other way, it will rise from the water and seize the insect in its mouth



An insect may be knocked high in the air, or may fall on the bank out of reach



The motion picture camera catches the shot in mid air



The author of the preceding article states that on at least two occasions to his knowledge a friend of his in Siam was sitting on his veranda beside a pool of archer fish, reading his newspaper and smoking an after-breakfast cigaret, when his attention was attracted by well-directed shots which extinguished his cigaret

n photos by Pathé

Emergence of the Butterfly

In the following series of photographs the camera has enlarged the various stages in the development from the mature caterpillar to the adult butterfly. Although we show here the transition of a common European swallow-tail (*Papilio*

machaon), the same changes take place in all butterflies. (The photographs employ more than one specimen to complete the sequence, but so regular is Nature that the substitution can scarcely be detected.)





PHOTOGRAPHS BY CROY, FROM BLACK STAR

(Left) The caterpillar has spent its time busily eating and has grown up enough to think of becoming a butterfly. It fastens itself by its tail to a plant by means of self-spun threads and thoughtfully provides a belt of the same material which is to prevent the pupa from chang-

ing its position. The actual length of the caterpillar is about an inch and a half

(Above) Shortly afterward the skin of the caterpillar splits open and the pupa emerges. Its shell is still soft and resembles the shape of the caterpillar



The pupa has acquired a hard shell which protects the soft interior where the change takes place. During this stage, that is so frequently referred to as the resting stage,

all the internal organs of the caterpillar break down into a uniform liquid mass and then reform in the shape of a butterfly containing all the essential organs



(Above) When the changes within the pupa are complete the hard shell bursts and the butterfly begins to emerge. The

pattern of its wings are already discernible through the shell



(Above) The head piece is dropped and the butterfly sees daylight again in a new form

(Right) the butterfly is now freed, but



its wings are still soft little sacs of scale-covered membrane. These wing pads will be stretched to full size by the pumping of fluid into them



(Above) The wings blossom out quickly. From the time when the butterfly began to break out of the chrysalis until it has

emerged and its wings are fully spread although not hardened is a matter of only twenty or thirty minutes

(Right) Before flight is possible the



wings must harden. They flutter spasmodically, probably hastening this process by increasing the rate of evaporation. The rate of hardening of the wings de-

pends upon many conditions, including the size of the butterfly and humidity. Some small butterflies emerge and are able to fly in as little as ten minutes



The butterfly is fully developed, even the long tails of the wings are fully grown. It is a light yellow creature with

black markings, and appears considerably larger than the inch and a half chrysalis from which it emerged

The Story of the Dinosaur Eggs

One of the epic tales of scientific exploration, told by a veteran of more than thirty expeditions

By WALTER GRANGER

*Curator of Fossil Mammals,
American Museum*

THERE has recently been installed in the Mongolian exhibit at the Museum a group representing *Protoceratops*, the small hornless member of the horned dinosaur group, together with its nest of eggs. The two skeletons shown are real; the eggs are casts of a model made from a careful study of the Museum's collection of fifty more or less complete eggs, and they have been arranged in exactly the manner in which they occurred in one of the several nests discovered.

Behind the scenes

The finding of these dinosaur eggs has been told many times but it is an interesting story and will, perhaps, bear repetition at this time.

When the Central Asiatic Expedition first entered the Gobi, in 1922, it was not known definitely that dinosaurs laid eggs. Reptiles of today have both oviparous and viviparous methods of reproduction—even with closely related species of snakes some lay eggs and others bring forth living young, and it was supposed that since dinosaurs are reptiles, some of them, at least, might have laid eggs, although none had ever been found. At Rognac in southern France some fragments of what seemed to be reptilian egg shells were found in strata bearing dinosaur bones and there is a possibility that these are really bits of dinosaur eggs, but they may also belong to other contemporary reptiles. In North America, where dinosaurs flourished as nowhere else in the world and where their bones, their gizzard stones, their tracks and their toothmarks abound, not a trace of their eggs had ever come to light.

I presume that nearly every American collector of dinosaurs has been on the lookout for their eggs and has hoped that some day he might find one, or better still, a nest of them. I know that many times during the years I worked the dinosaur fields I visualized such a happening but as the years went on it began to seem such a remote possibility that it finally took its place as another futile day dream. In 1923, however, in the very heart of Mongolia, hundreds of miles from the nearest civilized community, this dream became a reality and we did find dinosaur eggs—not only single eggs but a whole nest of them, lying very much as the parent had left them seventy-five or more millions of years ago.

First dinosaur egg

The first discovery of these eggs came the year previous in 1922. On our way back to China in the autumn our party was passing near this locality, although not in actual sight of it, and the motor cars had been halted on the caravan trail to wait while the scout car ran off to the side to inquire the way at a Mongol village which we could see two or three miles distant. Taking advantage of this delay Mr. Shackelford, a photographer by profession but a fossil hunter by instinct, wandered off over the desert and soon came to the edge of the platform on which we had been traveling. He found that its face dropped off abruptly into a set of brick-red badlands, just the sort of place in which one learns to look for fossils. Climbing down into these rich-looking exposures, Shackelford was immediately confronted by a well preserved but somewhat weathered fossil skull with the jaws still attached and resting on a buttress of red sandstone. It was a simple matter for him to break

the skull loose and he took it immediately back to the cars. It was identified at once as the skull of a reptile but its exact affinities were not determined until it was prepared in the Museum laboratory many months later.

This discovery seemed an important one to us and we decided to go into camp nearby and spend the remaining two hours of daylight in prospecting the locality. This prospecting resulted in the finding of many fragmentary remains of the same kind of animal. There was also picked up on the surface of the badlands a fragmentary and badly weathered egg shell which at the time was thought to be that of a bird, the eggs of which, although not common, are not really rare as fossils.

Later, when the bones collected that evening were determined at the Museum as belonging to a small member of the horned dinosaurs, it became evident that this badly broken and insignificant looking egg shell was actually the first positive dinosaur egg to be discovered.

Protoceratops andrewsi

The following year, realizing the full importance of these finds, we spent two months in scouring the area, named by us the Flaming Cliffs, with a large force of collectors, and we succeeded in obtaining several skeletons and more than fifty skulls of the little dinosaur which had already received the name of *Protoceratops andrewsi*. Of its eggs there were found many individual specimens mostly weathered out and lying on the surface, remnants of two or three nests where the erosion had left us only a small part of the original "clutch" of eggs and one nest where the erosion had only begun to make inroads and the greater part of the nest with no less than fifteen eggs was still intact. That was a great season for dinosaur eggs and while the scientific importance of the discovery was perhaps not so great as other discoveries made that year it did meet at once with popular fancy and did more than anything else to give the Central Asiatic Expedition public recognition the world over.

It may properly be asked, how do we know these are dinosaur eggs and how do we know they belong to this particular type of dinosaur known as *Protoceratops*? The answer is this: In the very limited area of Upper Cretaceous exposures at Flaming Cliffs extending along the face of the tableland for five or six miles

we found upwards of fifty more or less complete eggs and thousands of egg shell fragments representing at least several hundred more eggs. They were to be found everywhere from one end of the exposures to the other and throughout the one hundred and fifty feet thickness of the deposit. *Protoceratops* was also very common and its bones were everywhere, frequently in close association with the egg shells. There were a few other types of dinosaurs found there but they were very rare and of types too small and delicate to have laid any but the smallest eggs found. Reptiles, other than dinosaurs found in the deposit, are a single tiny crocodile and a few small aquatic turtles—both out of the question as possible parents of the eggs.

It seems reasonable, therefore, to assume that the greater number of these eggs belong to *Protoceratops*. The eggs are of the right size, they have been found in close association and there are no other animals of this fauna, so far as known, to which they could properly be attributed.

The eggs which we have assigned to this diminutive ceratopsian vary from five to eight inches in length. In shape they are long ovate, an unusual shape for modern reptile eggs which are usually oval or spherical. The eggs are smooth at either end but the rest of the surface is covered with a fine irregular wrinkling as seen in the photograph of the single egg. The shells were undoubtedly brittle because all show more or less cracking which would hardly have been the case if they had been leathery, as some reptile's eggs are. In all cases the egg shells are filled with the same material in which they are embedded—fine-grained sand which had evidently filtered in after the shells became cracked, and had replaced the soft contents of the shell.

Why Outer Mongolia?

The question naturally arises as to why dinosaur eggs should be found in abundance in one restricted area in Outer Mongolia and nowhere else in the world, barring possibly the fragments of shells from France and a few other fragments recently discovered by Princeton parties in northern Wyoming. The only satisfactory explanation is to be found in the nature of the strata in which these Mongolian eggs occur. The deposit is a uniform,

brick-red, fine-grained sandstone, so soft that it can easily be dug away with the finger nail. The geologists assured us that it was an aeolian deposit: that is, one laid down as wind-blown sand. At the time *Protoceratops* lived there it was evidently an area of drifting sand with probably a few small streams or ponds as indicated by the presence of the crocodile and the aquatic turtles. This then would account not only for the deposition of the eggs but for their preservation during the subsequent millions of years.

Eggs laid in circles

Sea turtles, of our time, come out of the water at night, climb up above high tide and there deposit their eggs in a pit in the sand and then after covering them carefully return to the sea, leaving the eggs to hatch by the heat of the sun. And so it is not difficult to visualize the female *Protoceratops* coming into the sand dune area, digging a pit and there depositing her twenty to thirty eggs at one time, covering them up and allowing the warmth of the sun to incubate them.

If one may judge from the several nests found, the arrangement of the eggs in the nest was always the same. They were in circles with the large ends up and tilted toward the center. In the case of the most complete nest discovered—the one used as a model for the group—there were five eggs in the lowermost circle and slightly above this was a much larger circle of eleven eggs. Still higher were the tips of two eggs indicating that there had been a third circle which if complete would have comprised about twenty eggs. The erosion of recent time, however, which had already removed the hundred or more feet of overlying

sandstone, had reached the nest before the fossil collector came along and had sheared off the upper ends of most of the eggs and had very probably removed entirely all but two of the eggs of the uppermost circle. At any rate there were eighteen eggs represented and it is not unlikely that the nest originally contained thirty or more eggs. In another nest the erosion, working on a vertical face, had cut away just half of the eggs leaving fifteen still in the bank.

The orderly arrangement of the eggs in the nests may have been brought about by adjustment with the front feet or the beak, but it seems more reasonable to suppose that the female simply rotated her body as the eggs were deposited. The shape of the pit, being smaller at the bottom, would, of course, automatically regulate the diameter of the various circles of eggs.

75,000,000 years later

Obviously none of the complete eggs found had hatched, although two isolated eggs picked up on the surface do show what appear to be traces of highly developed embryos. It is quite possible that there may have been a sudden accumulation of drifting sand on top of the nest, which, if not sufficient to crush the eggs, would at least have cut off the heat of the sun and so stopped incubation, or there may have been other reasons which we cannot readily conceive. Whatever the reasons are, however, we are grateful for them because these particular nests, failures in the eyes of nature, have been handed down through seventy-five million years of geologic time to assist us materially in interpreting the life of that time and place.



Baby dinosaurs emerging from the eggs

Drawing by John C. Germann from model by Mrs. E. Rungius Fulda

The Story of the



(Above) The first dinosaur nest discovered. One-half of the original nest of about thirty eggs was found under the sandstone mound; the other half had been eroded away but the eggs seen in the foreground had resisted the disintegrating process



(Left) The underside of a nearly complete nest with the eggs still in position but worked out in high relief. Note an inner circle of five eggs and an outer circle of eleven eggs with the remnants of a third circle

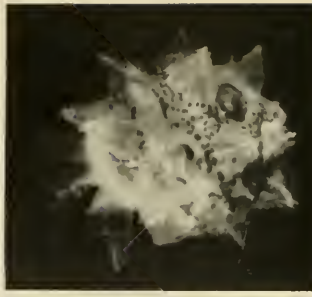
Dinosaur Eggs



(Above) 75 million years old. Filled with a fine-grain sand in which it was embedded this egg, smooth on both ends, has the rest of its surface covered with a fine irregular wrinkling

(Below) The newly installed Protoceratops group. The skeleton in the background was prepared and mounted by the late Peter C. Kaisen; the other skeleton was mounted by Charles J. Lang who also assembled the group





*Photograph by courtesy of
A. Fedel Taning*

(Above) The 1, 10 inch larva of the pointed-tailed ocean sunfish: a speck of living matter from which the ten-foot colossus of the sea shown below developed. The tiny larva is a free swimming creature, able to find its own

food. The comparisons which the author of the interesting article opposite draws, gives this fish a good claim to the title of growth-champion among animals

*Photograph by courtesy of
George Reddington*



From Atom to Colossus

Growth of the pointed-tailed ocean sunfish from one-tenth inch to ten feet,—an increase of 60,000,000 times its original weight

By E. W. GUDGER

*Associate Curator of Fishes,
American Museum*

THE attention of New Yorkers in particular and of the readers of the metropolitan press in general has recently been called to the birth of a little bear cub in the Brooklyn "Zoo." This small chap was about 6 inches long and weighed 12 ounces. The mother probably measured $5\frac{1}{2}$ feet from snout-point to tail-tip, and weighed about 200 pounds—these being the sizes for an average female bear.

Comparison among mammals

It has been estimated that a cub ordinarily equals about one two-hundredth of the weight of the mother bear; a puppy about one twenty-fifth as much as the mother; and a human baby about one-twentieth. In all these cases there is great discrepancy in size between baby and mother, but greatest in the bears.

This infantile descendant of the genus *Ursus* was in the course of nature born blind and hairless, and looking very unlike the bear he will grow up to be. Hence the fiction that the mother "licks the cub into shape"—a saying which by extension has come to be applied in a figurative sense to the young of the genus *Homo*.

The little cub referred to (and he was not only a cub but he *was* little) was taken from his mother and at first fed with a medicine dropper. Later, when he had grown a bit, he appeared in the news-reels as a bottle-fed baby who made strenuous remarks when his bottle was not forthcoming.

Most large animals give birth to large young, and contrariwise most small ones to

small young—whether mammals or fish. But before considering the most unusual case in the fishes, and perhaps the most extraordinary in the animal kingdom, let us turn for a moment to a most interesting land-dwelling mother and baby, the difference in whose sizes is very great.

The contrast between the just-born kangaroolet and the mother is tremendous—in fact it is probably greater than that in any other land-living animal. The average mother kangaroo is three feet from crown of head to root of tail, while the baby, or "Joey" that is to be, has a similar measurement of about an inch. The mother weighs about 100 pounds (1600 ounces), the infant a mere fraction of an ounce. The young kangaroo is born in a condition even more unformed and more unlike the mother than is the baby bear. This in part at least accounts for the great disparity in size of mother kangaroo and her kangaroolet.

But great as is the contrast between the just-born kangaroo infant and the adult into which it will grow, a far greater difference is now to be considered—probably the greatest for any member of the animal kingdom living today. I refer to the contrast in the ocean sunfishes—young and adult.

The ocean sunfishes

To many of my readers the name sunfish calls to memory the little short-bodied perch-like fish of our fresh-water lakes and streams. These lovely little fishes are of at least half a dozen kinds and are perhaps our most common fishes angled for by every boy. But the pointed-tailed ocean fellow is not only a seaw dweller but is infinitely smaller when he is small and vastly larger when he is large—as we shall see.

The ocean sunfishes are millstone-shaped fishes and for that reason have been given the family name Molidae. Two of them, *Mola* and *Masturus*, grow to a size in which length (over the tail-fin) and depth (over the dorsal and anal fins) amount each to more than 10 feet, and they attain to a weight of from one-half to three-quarters of a ton. They are the largest fishes with the smallest eggs and littlest babies known to me. Yet it must be noted that, unlike baby bears and kangaroos, their microscopic young when hatched out of the floating eggs are born into the waste of waters able to seek and find their own food—to fend for themselves.

The smallest pointed-tail

Among the treasures gathered, by the Danish "Dana" Expedition of 1920, from the Sargasso Sea, that great "dead water" of the North Atlantic Ocean, is the smallest pointed-tail ever recorded. This we owe to that master deep-sea oceanographer and ichthyologist, the late Johannes Schmidt of the Marinbiologisk Laboratorium in Copenhagen.

The little fish shown in the figure is only about one-tenth of an inch long. The illustration is made from a photograph obtained by placing the tiny fish under a microscope. On the printed page, the fishlet is enlarged 10 times. It is what ichthyologists call a larval fish—that is, one quite unlike the adult, and which must undergo some extensive transformations in the course of its life history in order to become an adult.

To get an idea how tremendously small (the phrase is justified) this little fish really is, let the reader get out a foot-rule and look at an inch-space marked on this. This inch will be divided into both eighths and sixteenths. The little fish shown in the figure is larger than one-sixteenth but smaller than one-eighth of an inch. In fact it is about the size of a capital O in this type. It is the smallest free-swimming larva of any large fish known to me. It controverts the general rule that large animals have large eggs and young.

Our fish are called pointed-tails, but it is clear that there is nothing pointed in the tail of the microscopic larva. The dorsal and anal fins are very like those of the adult, but, instead of the central spade-shaped lobe of the colossus in the figure, in the baby the body

ends like that of an ordinary young bony fish—in a stout stump with a paddle-shaped fin on the end.

But our pointed-tailed fish is *not* an ordinary fish, and in size and form the tails in the two ages are as far apart as the antipodes and as unlike as are the sizes and shapes of the two fish. The tale of how the tail of the little sunfish disappears and how the great and unwieldy tail-end of the adult *Masturus* comes into being, a tail-structure found in no group of fishes save the Molidae, or mill-stone fishes, is indeed "another story" which will be told in a technical article in another place.

The giant of the tribe of *Masturus* of the whole world is shown in the large photograph. For this photograph I am indebted to Mr. George Reddington of St. Augustine, Florida, in whose "Museum of Marine Curiosities" on Anastasia Island the fish is on exhibition. The readers of Natural History who go to Florida may at any time see it there.

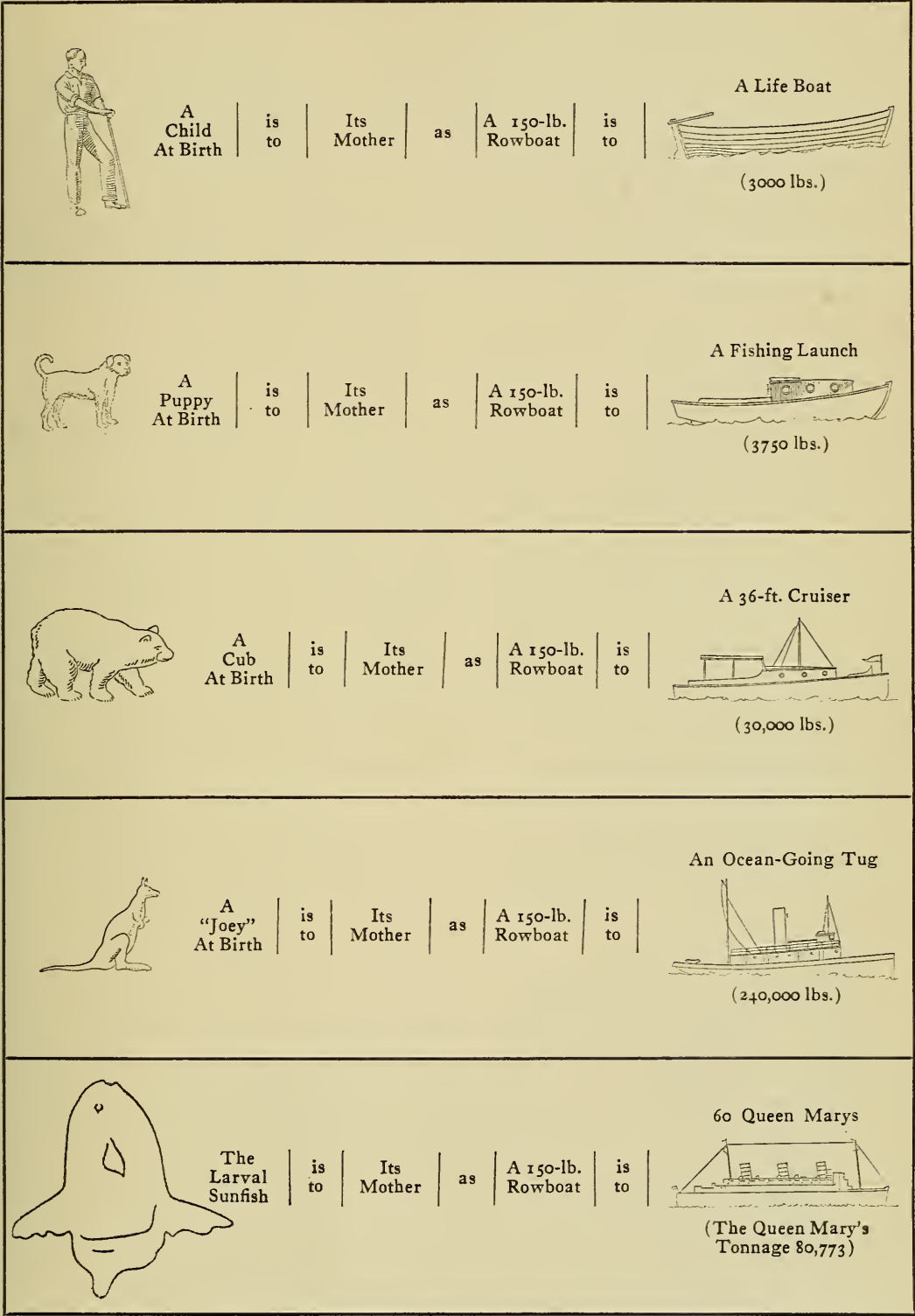
The colossus

This colossus among pointed-tails came ashore at St. Augustine Beach in 1912. There is today no definite record of its measurements, but Mr. Reddington has it that it was over 10 feet in length to the tip of the caudal "spade" as some call it, and 11 feet 3 inches deep over the great dorsal and anal fins. One can well believe this by comparing the height of the standing man with that of the fish. Today, after 24 years of drying and shrinking, the mounted fish measures 8 feet long and 9 feet 7 inches deep.

When fresh, this gigantic creature was too heavy and too unwieldy to be hoisted for weighing, but its weight was *estimated* at about 1700 pounds. This is probably too high a figure. But judging by my records of somewhat smaller specimens which were *weighed*, it seems likely that this great fish must surely have tipped the scales at over 1200 pounds. It is the largest and heaviest pointed-tail on record, a veritable giant.

Lest anyone think that this fish was a freak in size, it may be of interest to note that the next largest on record (also a Florida specimen, captured in a net off Daytona Beach in April, 1931) measured 8 feet 4 inches in length and the total depth was 8 feet 9 inches. Its great tail-fin, measured from the body

A CHART OF RATIOS TO SHOW BY COMPARISON WITH OTHER LIVING CREATURES THE PHENOMENAL GROWTH OF THE LARVA OF THE POINTED-TAILED OCEAN SUNFISH



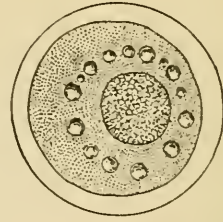
proper to the tip, was 2 feet 2 inches long. The lower side of the tail-lobe had suffered mutilation.

As the figure shows, the St. Augustine giant has a short rounded caudal lobe which has evidently been abbreviated. Examination of all published figures shows that almost all recorded adult specimens of this fish have mutilated tails. These sluggish and defenseless fish are readily attacked by sharks and barracudas, and the caudal lobe is the part most vulnerable and most often mutilated. Attention is called to the spots found on the great tail-fin. In almost all perfectly fresh specimens of the adult *Masturus* the body also is more or less covered with spots.

The egg

The reader has seen from what a microscopic larva (only about one-tenth of an inch long) our 10-foot colossus of the pointed-tailed tribe has grown. It would be interesting to know the size of the egg from which the larva of *Masturus* has developed. So far as I know no figure of such an egg has ever been published. But Johannes Schmidt has figured the egg of the first cousin of the pointed-tail, that of the truncate-tailed sunfish. This, shown in the annexed figure, was about one-twentieth of an inch in diameter—about half the size of a small letter o of this type. The fishlet which Schmidt hatched from this egg, when in the same stage of its life-history as our little fish, was practically of the same size and make-up as ours. I know of no other large fish which lays an egg anything like so small as this.

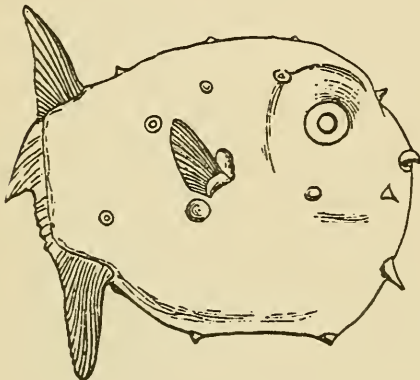
From all this it can be judged that the 10-foot colossus, shown in the large figure, de-



The egg of the truncate-tailed ocean sunfish, a cousin of the pointed-tailed fellow which grows so large. The natural size of this egg is about 1/20th of an inch in diameter. Here it is enlarged about 20 times.

(After Johannes Schmidt)

veloped from an egg about one-twentieth of an inch in diameter. What a prodigious amount of eating our great fish must have done! What its food is we do not surely know. This was long thought to consist of marine algae, but now the fish is known to feed in part upon the small transparent paper-thin larvae of the eel. But these are very small and likewise few and far between in the vast ocean. *Masturus* is, along with its cousins *Mola* and *Ranzania*, just about the poorest swimmer in the seven seas. Where and how it can find the larger and more abundant food out of which to develop its huge bulk, is one of the unsolved problems of the piscine world. With Shakespeare we may surely ask "Upon what meat hath this our Caesar fed that he hath grown so great?"



A 1 1/4 inch sunfish: a mid-way specimen which helped scientists to identify the "atom" as the offspring of the "colossus." Most such specimens are found in the stomachs of predatory fish; this one came from a kingfish in the middle of the South Pacific

(After Günther)

Islands West of South America

Further explorations on the schooner "Zaca."—To Selkirk's Juan Fernández, the rainless guano islands of Peru, and exotic Galápagos

By JAMES P. CHAPIN

*Associate Curator, Continental Old World Birds,
American Museum*

OFF the coast of Central Chile, a little more than four hundred miles out, lie the Juan Fernández Islands. The "Zaca," on her return from Easter Island,¹ had over fourteen hundred miles of ocean to cross before reaching Mas Afuera, the outer island of the group. With the good weather we now enjoyed, this was a voyage of ten days. Various occupations made them pass pleasantly.

A few birds in the ice-box still had to be skinned. We could watch the sailors as they fished from the bow for bonitos, small cousins of the tuna, which swam abreast of the ship. Jaques and I could always scan the water for birds, seeing petrels of several species, an occasional red-tailed tropic bird, or a solitary gray noddy. We even hoped to see an albatross, but it soon became evident that they remain well to the south of the 30th parallel, except in the cold waters close to the South American coast. Our last red-tailed tropic-bird, characteristic Polynesian species, was noted about 440 miles west of Mas Afuera. From there on we were in American waters.

Landfall

The morning we approached Mas Afuera its high southern extremity, rising to some 5400 feet, was capped with clouds. Here was an island as precipitous as any of the Marquesas, with gray cliffs and grassy taluses, where numbers of goats could be seen grazing. The upper levels on the mountains showed a good

¹This is the third and concluding article by Doctor Chapin, describing the Templeton Crocker Expedition to the South Pacific. Previous articles appeared in *Natural History* for November, 1935, and April, 1936.

deal of green bushy growth, but could scarcely be called well wooded, and the shores of the island seemed rather dry.

Its whole length is only eight miles, and we were soon anchored off the east side, opposite the old penal colony, abandoned some five years previous. I could not help contrasting our enthusiastic visit of a day with the enforced residence of those who had occupied the ten low buildings we found marked as offices, workshops, and *calabozos*. The headquarters of the *carabineros* suggested that the guardians may not have been much happier than the prisoners.

In such a place enthusiasm must vary inversely as the length of sojourn. In my case the only anxiety was to see as much as possible in so short a time. We knew that petrels must nest in burrows up on the mountains, and that there were several land birds: a large hawk, a hummingbird, a brown thrush, and two small brown birds of other South American families.

Island hawks

The hawks did not keep us waiting. Before we reached the landing-place two of them were seen flying about a large pine tree planted close to the buildings. Several more were found later, and although *Buteo polyosoma* is related to our North American red-tailed hawk, its representatives on Mas Afuera had no great fear of man.

Back of the penal colony a narrow valley, or rather a great gorge, extended inland. The brook in it had dried up to a series of stagnant pools, and about the rocks along it lived *Cinclodes oustaleti*, thrush-like in appearance but

belonging near the oven-birds. Jaques and Doctor Lyman offered to cover this valley, while with Jack, one of the Norwegian sailors, I was to take the zigzag road up the ridge on the north.

What I sought were woods in which the other birds might find shelter. We climbed 1500 feet before the grasses became interrupted by huge ferns, like tree-ferns without trunks. A little later the path veered to the right and traversed a gully filled with the low woods we had seen from below. In such moist places there were also typical tree-ferns with trunks fifteen feet high. A tangled "maqui" tree with small purplish berries attracted a pair of thrushes (*Turdus falcklandii*), but I failed to find either the hummingbird or the spiny-tailed *Aphrastura masafuerae*.

Petrel nests

As we climbed higher through these woods we began to see the burrows of gadfly petrels. Great numbers of the birds had been seen over the ocean at daybreak, and here were their homes. Jack dug out a few of the holes without finding any occupied, but several dried carcasses lying near by were readily identified as *Pterodroma externa*. Another smaller species, *P. leucoptera*, is likewise known to nest on the island, probably at a higher level.

After crossing several wooded gullies, the trail ended near a rough shack with a corru-

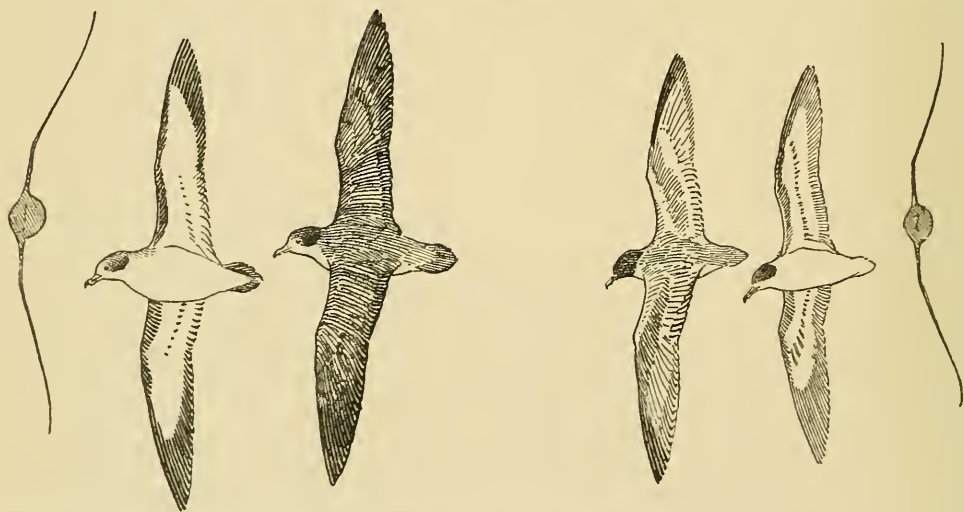
gated iron roof. Inside, the ashes of a fire seemed not more than a few months old, and I felt as though I had stumbled on the abode of Robinson Crusoe. This camp was probably used occasionally by goat-hunters from Mas Atierra.

We walked uphill through open groves of trees with grass beneath, until these woods ended at 2200 feet. Above that there were clumps of tough ferns, four or five feet high, and a few tree-ferns with short fronds. As far up as we could see, ferns dominated the landscape. Looking down into a moist ravine, Jack spied some foliage like giant rhubarb leaves, five feet broad, with stems at least six feet long. So we climbed down to where these amazing leaves grew from a fleshy trunk that seemed covered with shaggy red hair. *Gunnera peltata* is a justly celebrated plant, and though native only to the Juan Fernández Islands, it has been grown widely in botanic gardens.

Off for Mas Atierra

To get down to the landing-place took little over an hour, and by five in the afternoon we were sailing away. Soon we were surrounded by the evening assembly of petrels, hundreds of them sailing low over the water, as they prepared to revisit their nests. The sun set directly back of the deserted prison-island, and we headed for Mas Atierra.

A schooner sighted shortly after midnight,



Two of the common Pacific types of gadfly petrel (*Pterodroma*), showing the upper and lower surfaces as they are seen when "banking" in the wind

the second ship seen out of sight of land since we left California, was bound in the opposite direction on a fishing or hunting trip to Mas Afuera.

Early next morning Mas Atierra and its smaller neighbor, Santa Clara Island, were in plain view on a smooth ocean, with petrels of several kinds as well as shearwaters in view. At first these islands looked even more arid than Mas Afuera. As we approached the northern corner of Mas Atierra there were high cliffs, and then the Sugarloaf, a 2000-foot mountain with a tiny cap of woods and a few of the indigenous *Juania* palms.

A real Robinson Crusoe

Beyond Sugarloaf was a small bay with a cave in the rock near shore—Selkirk's Cave. It was here that Alexander Selkirk was put ashore in 1704, to live alone for four years and four months, and thus to provide Defoe with material for *Robinson Crusoe*. While the lower ends of the valleys still looked very dry, extensive woods could be seen inland at the bases of the mountains. There the island is far more richly wooded than any part of Mas Afuera.

Finally we came abreast of the village of San Juan Bautista, where a large white building on the shore was the headquarters of an important lobster company. The catch is shipped to Valparaiso. Behind the village rose mountains the highest of which is known as "El Yunque" in allusion to its anvil form. The higher end rises a little over 3000 feet.

Hugo Weber, one of the crew of the "Dresden," sunk in this harbor during the World War, came back with his wife a few years ago to live on a farm near the base of El Yunque. My day was spent in an excursion to Weber's farm, a clearing surrounded by beautiful forest; and there I met Charles Bock, a veteran collector of birds and plants. Our road led up through woods at first composed largely of "maqui" trees, introduced from South America, and now spreading with dangerous rapidity. Just before reaching the farm we came into the indigenous forest, with large trees of many species and undergrowth rich in ferns.

About the Weber's home were flower gardens that attract hummingbirds, especially the smaller green *Sephanoides sephaniodes*. Along a path at the edge of the woods we began to

see the larger *Thaumaste fernandensis*, the species which had eluded us on Mas Afuera. The males are largely rufous, the females glossy green above, whitish beneath. Unless forewarned one would take them for two distinct kinds of hummingbirds. A favorite tree with this bird was *Raphithamnus venustus*, full of small tubular blue flowers. Whenever we noticed such fallen flowers, we would almost certainly find the hummers chasing each other or feeding overhead.

In swampy places in the woods Mr. Bock showed us a splendid patch of *Gunnera* plants, and likewise some of the rarer examples of the flora which he had transplanted from the higher mountains. Mas Atierra is an island to arouse the enthusiasm of a botanist.

As we left our anchorage early the next morning a school of six or eight killer whales escorted us for ten minutes or more. Two and a half days of very easy going brought us within view of the Andes, and only a few hours before we sighted South America Jaques saw the first albatross. It was near the same place, too, that small flocks of phalaropes began to show themselves. Probably of the species called the red phalarope, they were in gray-and-white winter plumage, looking for all the world like sanderlings when in flight. These lobe-footed shorebirds breed in the Arctic and then seek the southern summer at sea, even beyond the Tropic of Capricorn.

Birds of the cold current

We had almost failed to appreciate the narrowness of the fringe of cold water welling up in the Humboldt Current. The morning of February 4, 1935, we arose at daybreak to see the peak of Aconcagua, and in two hours were off the harbor of Valparaiso. The skuas, gulls, terns, pelicans, cormorants, and boobies characteristic of the cold water seemed almost to hug the shore. They all showed up when I was below, shaving, to Jaques' great amusement.

At Valparaiso we were back again in civilization—strikingly so. The influence of climate on human society here finds eloquent expression. Moreover, we were among friends. Local naturalists and American consular officials greeted us warmly, the press pictured us on the front page. We tied up alongside Mr. W. K. Vanderbilt's yacht "Alva," and I met my old friend William Belanske, his ar-

tist-preparator. A little farther along the mole was the Chilean training ship "Almirante Baquedano," the name of which we had seen painted on the Easter Island statues.

Our stay of eight days in Chile would deserve an article in itself. Suffice it to say that Mr. Crocker, Doctor Shapiro, and Mr. Jaques visited Santiago, and then Jaques and I made a two-day trip by train and auto to the Argentine frontier. From the base of the statue of Christ the Redeemer on a cold Andean pass we gazed upon the snowy summit of Aconcagua. In the afternoon Lincoln Ellsworth flew over us in a passenger plane from Mendoza to Santiago.

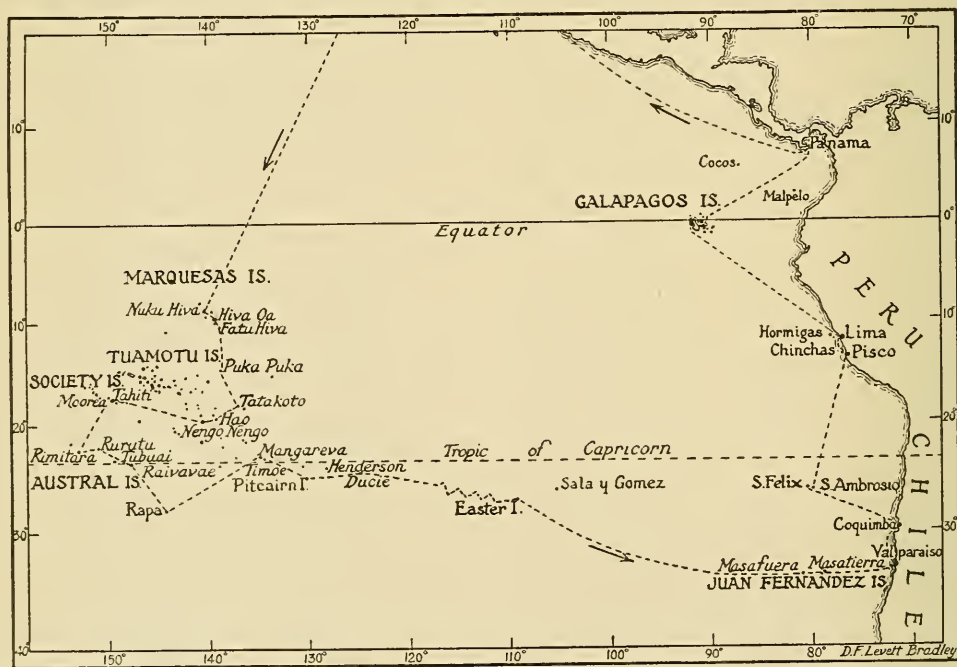
At Valparaiso we bade goodbye to Doctor Shapiro, whose work had been completed. Henceforth we would confine our attention to islands of no anthropological interest, but we were sorry to lose his ever-cheerful companionship.

If I was disappointed at seeing so few of the Humboldt Current birds before reaching Valparaiso, I had no regrets as the "Zaca" bore us northward along the coast to Coquimbo. Now

we met the albatrosses, diving petrels, large skuas, black-backed kelp gulls, gray gulls, Inca terns, brown pelicans, guanay and red-footed cormorants, and Peruvian boobies. These are only the common species of the assemblage described so masterfully in Dr. R. C. Murphy's *Bird Islands of Peru*.

Coquimbo was our point of departure for the barren volcanic islands of the San Felix group, lying about 400 miles off the coast of northern Chile, near latitude 26° S. After a single night at sea no more cold-water birds were visible, and we began to see petrels like those of the Juan Fernández Islands. Another three days and we awoke to find ourselves approaching San Felix, having already passed the much higher island of San Ambrosio.

Eleven miles apart, they both are rocky and treeless, at first apparently devoid of vegetation. A third island, Gonzales, lies close to San Felix, as though they might be remnants of some old gigantic crater, now chewed apart by the relentless ocean. Flocks of sooty terns flew out to meet us, and a few white boobies with black wing-quills. The principal reason



THE ROUTE OF THE CROCKER PACIFIC EXPEDITION

The "Zaca" which carried the party almost 14,000 miles through the Pacific, is a two-masted schooner, 118 feet over all. The pres-

ent article describes the last leg of the journey, from the Juan Fernández Islands north to Panama

for our visit was to make a list of the resident birds for Doctor Murphy. He had seen a poor photograph of a booby taken at San Felix, where they were said to have nested in great numbers before the Chilean earthquake of 1922. The only species of booby we saw here was this masked booby, *Sula dactylatra*, so the puzzle was solved.

The western end of San Felix is formed by a high yellowish hill of soft tufa. On this elevation we at last made out scattered low bushes covered with gray-green foliage. To the northwest of the anchorage a gray cathedral-like rock rose from the sea. The only landing-place on the island was a ledge beside a deep cave, where an old rope dangled down the low cliff. The rope had apparently been left by the training-ship "Baquedano," for its name was painted on the rock.

Ashore on San Felix

Our second officer climbed up the old rope and attached a safer one for me. With a sailor-companion I was then able to wander all over the dusty top of the island. Traces of a few old booby nests were seen, but only one pair still attended patiently to their egg, which was hopelessly addled. They may have been waiting months for it to hatch. The sooty terns and gadfly petrels (*Pterodroma cookii*) had practically finished nesting; all but a few of their young were on the wing. Gray nodies alighted confidently on the rocks about us, but had no nests.

On the lower section of the island, built of successive flows of brown-black lava, there were low round bushes of purplish sea-blite, and a very few examples of a grass and a mallow. Four species of plants were all I could find. The only conspicuous insects were large flies which swarmed upon us, especially in the spots where colonies of terns had nested.

In the afternoon the "Zaca" took us back to San Ambrosio. Here the bare forbidding cliffs, hundreds of feet high, made me doubt that anyone had ever climbed them. The very top of the island, rising to 1470 feet, was well covered with greenish bushes, over which hundreds of large petrels (*Pterodroma neglecta*) could be seen circling. They evidently had a well protected breeding community there.

As night fell white-bellied storm-petrels

(*Fregetta grallaria*) made their appearance around the yacht, as birds which had been feeding offshore came in to replace their mates on the nests.

I have since learned to my surprise that in 1869 Simpson reached the summit of San Ambrosio and brought down in his hat specimens of its plants. Seven of them do not occur even on San Felix.

To the guano islands

Our next port was Pisco in Peru, just inside the Chincha Islands, the best known of all the guano islands. Here millions of seabirds unwittingly add to the revenues of the Peruvian Government. We were to collect materials to show the guanay cormorants. (*Phalacrocorax bougainvillii*), Peruvian boobies (*Sula variegata*), and brown pelicans (*Pelecanus thagus*), which nest on these rainless islands in incredible numbers. In prehistoric times their excreta raised the elevation of one of the Chinchas by 180 feet.

During the nineteenth century this accumulation of fertilizer was dug down and exported even to the opposite side of the earth, its exploitation sometimes accompanied by the utmost brutality toward the workers. Moreover, the birds themselves were dangerously depleted in number before the government of Peru awoke to the wisdom of protecting the birds to insure a permanent supply of guano.

Now, before landing on the Chinchas, we would need a special government permit. Thanks to my colleague, Doctor Murphy, and his good friend, Señor Ballén, director of the government guano administration, this permit was awaiting us at Pisco. So we recrossed the bay, plowing through a great flock of "guanayes" busy with their fishing, and anchored between the North and the Central Island.

We were greeted by the guardians of the islands, whose chief inspected our official papers; and they began by showing us over the Central and South Islands. The North Island was black with a new brood of full-fledged "guanayes" or cormorants, and from morning till night their parents streamed out in long lines toward the fishing grounds.

Around the cliffs were the colonies of Peruvian boobies or "piqueros," and on top of these declivities sat rows of huge brown pelicans, at once sedate and foolish-looking. On

the wing they would become majestic. Low down on the rocks flocks of Inca terns with white ear-rings of feathers took their repose, while there, too, and especially near caves, one might see small parties of Humboldt penguins.

The Central Island had only a small colony of "guanayes" still sitting on their nests, and the same was true of the South Island, which had recently undergone a "harvest" of its guano. No blade of grass or twig of a bush could be found on any of the three islands. But cormorants must have nests, so these utilized the cast-off wing and tail quills of their own kind, building a soft if filthy cradle in which to lay their eggs. Most of the nests held newly hatched young, ten times homelier than any ugly duckling, with small black heads and snaky wrinkled necks.

Planning a bird group

Jaques, with practiced eye and previous experience of the Peruvian islands, quickly chose the south end of the South Island for his background, with the Ballesta Islands and San Gallan in the distance. It was my sorry duty to gather the specimens to be placed in the foreground of the group. Nothing but birds painted in the background can ever give an idea of the numbers of sea-birds about these islands.

Down below us on the stony beaches dozed hulking bull sea-lions, with their smaller mates and progeny. The protectors of the birds, I am sorry to say, frequently shot the sea-lions; yet the latter seemed in no danger of extermination. In three days we went over the islands thoroughly, taking photographs, collecting the number of old nests needed, and what few other accessories could be had. Nearly all my birds were obtained over the water. Ashore the air was frequently nauseating, and even as the "Zaca" left to sail northward toward Callao it passed to leeward through a fog of white dust and down-feathers.

The following morning, as we rounded the mountainous island of San Lorenzo to enter the harbor of Callao, looking in vain for a possible condor, the guano birds were all about us. Our stay of four days, with frequent visits to Lima, was largely devoted to sight-seeing. An Exposition of the Fourth Centennial of the Founding of Lima was in progress, where ornithological exhibits from the Uni-

versity Museum were on view, including a habitat group of guano-producers.

Right after leaving Callao we paid our farewell visit to a pair of small but remarkable bird-islands. Some thirty-five miles offshore are the "Hormigas de Afuera," the "offshore ants," low bits of rock where guano cannot be gathered because of the dangerous surf. Their tops would be pure white were it not for the army of "piqueros" nesting on them, leaving room only for a herd of fifty sea-lions on the larger one and ten more on its smaller neighbor. There were also, to be sure, a small group of twenty "guanayes," and some Inca terns on rocks too steep for the larger birds. Strings of "piqueros" kept flying in until we were watching them cross the red disc of the setting sun.

On all sides the breakers roared, sending their spray higher than the dark rocky wall of the islets that rose only twenty-five feet above sea-level. Any attempt to land would have been foolhardy, so we were unable to learn anything of the nesting of the small storm-petrels which appeared after sunset. Rollo Beck had had the same experience here.

Isles of the tortoises

That evening the "Zaca" set out for the Galápagos Islands, about a thousand miles to the northwest, where the ocean water is some ten degrees warmer than that of the Peruvian coast. Consequently the sea-bird fauna is almost totally different. Now it was early March in 1935, and I was to revisit the islands where I had gone five years before as a guest of Vincent Astor on his yacht "Nourmahal."

Some of my friends, even after visiting the Galápagos, describe them as cool and comfortable, despite their equatorial location. I am a violent dissenter, in so far as the months of March and April are concerned, when my visits occurred. Other seasons may be different. Shortly after the turn of the year the rains arrive in the archipelago, the air warms up and becomes sticky. A cooling breeze may blow on the beach or over the mountains, but nowhere have I ever been more freely bathed in perspiration than while finding a way amid the cactus thickets of the Galápagos, just back from the shore.

Yet these islands are superlatively attrac-

tive to a naturalist, more so than the beautiful ones we had visited in Polynesia. Life is so much more abundant on them. Giant tortoises are still to be found, land-iguanas with the bite of a steel trap, other iguanas diving for seaweed in the ocean, hawks without fear of man, mockingbirds and flycatchers bold and inquisitive, pretty doves most peaceful of all, and the smallest barn owls in the world. Among mammals there are sea-lions and a few surviving fur-seals, but only a couple of species of native rats.

The avifauna of the Galápagos, first studied by Charles Darwin in 1835, is now exceedingly well known. It offers wonderful examples of the efficacy of isolation in the origin of species and subspecies—much more complex, probably, than Darwin suspected. In the celebrated case of the finches (*Geospiza* and allies), while a few species are restricted to a single island, the majority are found on several islands, and may or may not be divisible into local races.

Indefatigable Island, for example, is inhabited by eleven species of these small birds. It would seem that species first developed through isolation and later came together without interbreeding. One may claim that every step in the development of a species, or even a genus, can be followed.

Our party could not undertake an extended survey. The task was to select a spot well stocked with land-birds, with suitable scenic properties, and to collect all that would be needed in the Whitney Hall.

Approaching from the southeast, passing Hood Island, to my regret, at night, we sighted first the southern end of Albermarle and continued around the western side. The first afternoon a landing was made on a rather barren lava-field just south of Elizabeth Bay, where a few small Galápagos penguins were the birds of greatest interest. Consorting with tropical brown pelicans, yellow warblers, and an egret, these penguins were a paradox in an order of birds so often associated with bleak coasts and Antarctic ice.

Aims in the Galápagos

Our next stop was in Tagus Cove, also on Albermarle Island, its steep rocky wall adorned with forty-seven names of yachts and tuna-fishermen in white paint. To "Zaca,

1932" was added "1935." Below these mementos sat groups of marine iguanas, four large brown cormorants (*Nannopterum harrisi*) with wings too small for flight, pelicans, blue-footed boobies, turnstones, and wandering tattlers. No penguins were visible; I fear that they had all been exported to zoölogical gardens. A brief excursion convinced us that neither the thin bushy vegetation nor its resident land-birds were adequate for our group.

More flightless cormorants and penguins were seen on the north shore of Narborough Island before we circled the north end of Albermarle to double back toward Indefatigable. At James Island, on the way, we stepped ashore in a particularly well wooded bay; but eventually we chose a site for our group at Conway Bay on the northwest side of Indefatigable Island.

Plants and birds

The rough lava hillocks here bore low woods of *Bursera* and other trees, with large cacti of two kinds. Finches were numerous and varied, a very conspicuous black species clambering about the *Opuntia* cacti, pecking at flowers or fruit. Other kinds ate berries and seeds, or devoured the green caterpillars so abundant at this season. Leaves were growing rapidly on the trees, showers were not infrequent.

The view northward included so many islands as to give a vivid impression of the Galápagos as an archipelago. Frigate-birds, brown pelicans, blue-footed boobies, and lava gulls were passing continually. Mockingbirds came to inspect Jaques as he painted the scene in oil under a canvas shelter. Blue-black martins came flying over from Eden Island.

Nearly two weeks were required to complete our work. Fresh bird-skins were desirable, as well as many sections of woody plants and cacti to be reconstructed in the foreground. Some of the crew aided us ashore, others ran the small boats to and from the yacht, and under Mr. Crocker's supervision every detail was organized for comfort and efficiency.

My rat traps here caught nothing except introduced black rats. One evening I found the sailors collecting the tropical clawless lobsters in the rocky shallows. About fifty of them were boiled in sea-water in a large iron barrel, and never have I tasted better lobster.

But the cloud of mosquitoes around the fire was almost unbearable.

At Conway Bay our bird-group work was ended. We still had time to visit Academy Bay on the south side of the island, where an unsuccessful attempt had been made to found a Norwegian fishing station. The governor of the archipelago was there on a visit, and among the several European residents were Stampa and Wold, who had assisted us during the "Nourmahal's" visit in 1930. In that year there were but three men living on Indefatigable.

An old friend

The third was Elias Sanchez, an Ecuadorian, whom we had discovered hiding behind the banana plants on a farm in the interior. He was watching us, and very suspiciously, until Kermit Roosevelt addressed him in Spanish. Now in 1935, along the trail leading inland, I again came face to face with Sanchez, beaming with joy at our meeting.

The population of Academy Bay has now increased to about twenty-three, including Mr. and Mrs. Rader, Messrs. Finsen and Worm-Müller, Scandinavians, and Mr. and Mrs. Küppler, Germans by birth.

The place used to be celebrated for its hawks, forty or fifty of which could always be seen sitting around on trees and buildings. They were so tame that not only could they be snared with a loop on a pole, but actually induced to perch on a rake and lifted a few feet down before they took wing to regain their perch.

We know that the principal food of this bird (*Buteo galapagoensis*) is huge centipedes; but because of fear that it might attack chicks, it has been slaughtered until now one sees but four or five in a day. The doves (*Nesopelia galapagoensis*) have disappeared for another reason; they were too palatable.

It must be added, however, that the Ecuadorian Government has recently set aside as wild-life reserves a great many of the uninhabited islands. The strict regulations against destruction of the native fauna there should prevent extermination of any of the remarkable species.

Our last morning in the archipelago was spent at Darwin Bay on Tower Island, where a populous colony of frigate-birds breeds unmolested year after year. They are all of one

species, *Fregata minor*, whereas on Indefatigable Island only *Fregata magnificens* was commonly seen. When a ship enters Darwin Bay a flock of these great soaring birds gathers above it, but without one adult male among them. The majority are females, with dark heads and white breasts. A few immature birds can be recognized by their white heads.

Even from the anchorage some of the males can be seen sitting on their nests with red throat-sacs inflated. Others are in the air, but they avoid the ship. The stick nests are mostly on low bushes not far back of the shore; and in two different years I have seen the colony very active, with eggs but no young nestlings, in late March and April. How long their breeding season lasts I cannot say, but this would seem to be its commencement. A few masked boobies make their homes on the ground, while red-footed boobies build most of their nests a little higher in trees. Beautiful forked-tailed gulls (*Creagrus furcatus*) incubate their eggs or tend their chicks on rocks close to the shore. Gray lava gulls (*Larus fuliginosus*) gather on the beach, but seem not to nest here.

The sun beat down with an ardor that was fully equatorial. We had drunk all the water in our canteens. Yet it was not without regret that I quit this torrid shore for the cool comfort of the "Zaca," wondering whether I should ever pay it a third visit.

Farewell to the Pacific

Five and a half days later we were off the Pearl Islands in the Gulf of Panama; and early the next morning, the first of April, 1935, we docked at Balboa. Old friends waited on the dock: Mrs. Jaques, Doctor Chapman, James Zetek, and Doctor Guillermo Patterson. Patterson and I were school-mates; Doctor Chapman has watched over me almost since my school days. Largely to Zetek we owe the Barro Colorado biological station, where Doctor Chapman soon took me.

Since I had been signed on as Purser of the "Zaca" I received my Certificate of Discharge at Balboa. The notations concerning my ability and my seamanship I consider altogether too flattering. For six and a half months I had been privileged to watch the ocean, the islands, and the birds. For that I give thanks to Mr. Crocker and the Museum.

Islands West of South America



Toshio Asaeda

Except for a few eucalypts and pines there was no shade about the deserted penal colony on Mas Afuera, the outermost island of the Juan Fernández group. Located at the mouth of a great gorge, it needed no prison wall, many miles of ocean serving far more effectually



The largest leaf, save those of palms, that I have ever seen. Jack Ratikan, a sailor born north of the Arctic Circle, holds up a Gunnera leaf and flower-spike



A Gunnera plant in the woods on Mas Atierra. Mr. Bock, who stands by its stout trunk, is an enthusiastic collector of plants, and volunteered to guide us on our short visit to this island



The main village on Mas Atierra, named after St. John the Baptist. The notch in the ridge behind, some 1800 feet above the sea is Selkirk's Lookout, where he could watch for a sail on opposite sides of the island. The middle slopes of the mountains are well wooded, the shore decidedly arid



Toshio Asaeda

(Above) View over the harbor of Valparaiso, with the "Zaca" moored beside the "Alva" and Chilean naval vessels (Right) a Close-up of the venerable training ship "Baquedano"





(Above) San Ambrosio Island from the west. Its forbidding cliffs make it a fortress for nesting petrels, and on its summit grow a dozen or more species of plants that illustrate the effect of long isolation from the continent

(Below) The only place to land on San Felix, at the left of a deep cave worn by the sea. Successive flows of lava are indicated by the bands in the cliff, which show that originally the island was very much larger

(Photo by Toshio Asaeda)





(Above) View along the barren plateau of San Felix. From these high black cliffs the ground slopes gently in the opposite direction toward the landing place. Gonzales Island in the right background

(Below) A masked booby of San Felix on her nest. Restricted to the warmer oceans, this species is found around the world. The gannets of the colder oceans are near relatives of boobies





Toshio Asaeda

(Above) The Chincha Islands are well equipped for the loading of guano into ships. Each island has its piers, and here and there are quarters for the guardians and the workers

(Below) Those "very strange birds," the pelicans, live on the tops of many cliffs, from which they can readily take wing. The passing of our motor boat, however, rarely disturbed them





(Above) Inca terns feed in flocks low over the water, and rest on steep rocks along shore. At first glance so strikingly different from others of their family, they are perhaps most closely related to the plain-colored noddies

(Below) Two Peruvian bird-protectors on the Chincha Islands, with some of their charges, guanay cormorants, on nests near by. The hollows in the white surface of the island mark the location of myriads of old nests





(Above) An old male sea-lion rears his head from the water, in concern or perhaps out of curiosity after his companions have deserted the shore at our approach. Ungainly they may be on land, but once in the water these sea-going carnivores are marvels of grace and speed





Toshio Asaeda

(Above) This picture may be suggestive of a penguin island, but really shows a colony of strong-flying cormorants. Their numbers were augmented by a new brood of full-grown young

(Below) The genesis of a Chincha Island background. Mr. Jaques makes his initial sketch of the rocky headlands and the distant islands from the site of the future bird-group

Toshio Asaeda



Mr. Crocker examines the mail at the "P.O. Tagus Cove," on Albemarle Island. The box was first set up in this uninhabited bay by Mr. W. A. Robinson so he could receive mail from home by any fishing boat or yacht
(Continued opposite)



(Below) A peaceful section in a colony of the guanay cormorant. According to Doctor Murphy this is "the most valuable bird in the world" as appraised by the total rent it pays for its ill-smelling tenements

(Photo by Toshio Asaeda)





that came there from Panama, even though he might be away on some short cruise. Here also Mr. Robinson would have died of appendicitis if he had not been able to send a radio from a California tuna-boat

(Photo by Toshio Asaeda)

One of the prominent residents of Tagus Cove, a flightless cormorant. These birds, unknown before 1898, are among those most in need of protection, as they are found only in a small western section of the Galápagos





(Above) At Conway Bay on Indefatigable Island Jaques was making a beautiful reproduction in oil of the broad expanse of beach, sea, and islands to be shown in his background. The burning sun made an awning necessary, while the fresh breeze rendered guy-ropes advisable

(Photos all by Toshio Asaeda)



(Left) A great blue heron on the rough lava shore of Conway Bay. It differs very slightly from the North American race of the same species, whereas certain of the other water birds are more markedly divergent from those of the mainland



(Above) One side of Conway Bay, with Eden Island a little off shore. "Eden" it is, perhaps, for marine iguanas and birds. This view is only the left end of the background as planned; to the right many other islands were visible

(Below) A Galápagos green heron that appears to have seen something. When in repose it would draw in its neck so as to appear nearly half this size. This bird is much sootier in color than its relatives on the American mainland.





(Above) Mr. Clarence Hay, in 1930, demonstrating how little a Galápagos hawk fears to be taken for a butterfly. Tameness is an outstanding characteristic of many Galápagos birds



(Left) Galápagos mockingbirds are sturdy, venturesome, and inquisitive members of their clan, also less musical than many. There are marked differences between the several forms in various sections of the archipelago, this one being native to Indefatigable

(Photo by Toshio Asaeda)

(Right) One of the brownish Galápagos finches, many of them the females or young of birds that become black in the adult male. In other species even the male may always be brown. To the biologist these are birds of special historical and evolutionary interest

(Photo by Toshio Asaeda)



(Below) A black cactus-finch perched on its favorite food-plant, the Opuntia cactus. It may be responsible for the sizeable hole below. Its nest is placed amid the spiny pads of the same cactus

(Photo by Toshio Asaeda)





(Above) Looking proud as a rooster, with gleaming hackles on his back, the male frigate-bird seems also to imitate the pouter pigeon



(Right) A young frigate-bird fully capable of flight, still frequenting the old homestead on Tower Island. When it has stolen enough fish from other birds it will mate and start housekeeping too

(Photo by Toshio Asaeda)



(Above) The majority of red-footed boobies in the Galápagos remain in a nondescript brown plumage, instead of becoming almost wholly white. They are very fond of perching in trees

(Photo by Toshio Asaeda)



Mr. Toshio Asaeda, photographer, tests the wood of an Opuntia tree

Except in its large brown eye, encircled by red skin, the fork-tailed gull when incubating shows little distrust of a human visitor

(Photo by Toshio Asaeda)



Perpetual Ice Under Lava

A natural "ice-box" in New Mexico, where the motorist can find welcome relief from the summer sun and an interesting scientific puzzle to solve

By JOHN STEWART MACCLARY

A LAVA bed whose surface is unpleasantly warm to the touch does not seem a likely setting for a deposit of perpetual ice. Yet in just such a locality, where the brazen New Mexican sun beats down upon a surface which once was molten stone, a deposit of perpetual ice does exist.

Signboards lead the traveler to a volcanic sink, an abrupt depression of an estimated depth of seventy-five feet. This was produced when a natural tunnel in the lava bed caved in. The tunnel was caused by the flowing away of molten lava from the lower part of the bed after the upper surface had cooled and hardened.

The floor of the sink is covered by jagged chunks of grayish black basalt which once formed a roof above the cavity. The accumulated warmth of the air in the depression strikes one almost like the blast from a furnace. One wonders how ice could possibly withstand a temperature such as this.

A hoax?

A skeptical mind prompts the cynical thought: "Just another 'gag' to snare the credulous tourist!" But there is no admission charge, there is no tip-seeking guide, and another sign insists that the Perpetual Ice Cave can be seen at the end of the trail which leads down into and around the volcanic sink. Irregular chunks of fallen stone block what seems to be a cavern in the wall of the sink. As the perspiring visitor approaches this rubble, the air becomes noticeably cooler. Perhaps, after all, the cave of perpetual ice is not a myth.

By this time a feeling of eager expectancy

has seized the visitor. He climbs the heap of fallen stone that obstructs the mouth of the cavern. At the summit of the disorderly pile he gazes down into the depths whence comes the current of cool air.

The sight which greets his eyes is well worth the effort he has spent. Imagine a bank of solid ice, mild aquamarine in color, from 12 to 14 feet in height and some 50 feet in width, calmly resting in a tunnel of what once was molten stone—the hottest manifestation of the earth's internal heat!

Feeling is believing

The visitor touches the ice with an experimental finger. Yes, it is ice—not some illusory mineral crystal. Gone is all skepticism. If the bank of ice can withstand the heat of this August day it must deserve the qualification "perpetual."

The ice is horizontally banded by strange dark lines of stratification. The nearly vertical face of the mass is gracefully curved from left to right. There is very little water from melted ice at the base of the deposit, and what there is registers 32 degrees Fahrenheit. The temperature of the air in the volcanic sink just outside the mouth of the cave is that of a cloudless August noon in the desert of western New Mexico.

The beholder is naturally perplexed as to how the ice was formed and why it does not melt away.

Its presence so near the hot surface of the ground depends primarily upon the fact that lava is among Nature's most efficient temperature insulators. The lava contains an infinite number of minute pores and cavities, and the dead air in them hinders the transmission of

heat through the stone from the sun. Once the bulk of a lava deposit has become thoroughly chilled to its depths, heat from the sun cannot penetrate the frigid mass. The cold which produces the ice probably comes from far below the surface. The ice is formed at a point where moisture filtering downward from the surface is met by frigid air from the depths of the insulated volcanic tunnel.

The only warmth which reaches the ice deposit comes from infrequent swirling gusts of air that has been heated in the volcanic sink beyond the obstructing rubble at the mouth of the cavern. The effect of such eddies of warm air is seen in the curving outline of the face of the ice deposit.

The bluish-green tint of the ice is probably produced by pollen wafted onto the ice surface at times when the mass was slowly forming, from pines that grow on the lava outside. The darker bands of stratification were formed by layers of dust similarly deposited. From a distance, or from a photograph, it might be supposed that these bands could be used as reference marks for tracing the age of the deposit as are growth rings in a tree. Actually, the dust bands are not distinct when seen at close range.

Age

It has been said by competent geologists that the lava bed in which this ice deposit is found is of comparatively recent formation. The geologist's interpretation of the term "recent," however, differs from the historian's. On the surface of the lava flow are magnificent yellow pine trees, having trunks more than three feet in diameter. The yellow pine grows slowly in a land where moisture is scant; moreover a fresh bed of lava would not at once offer soil for vegetation. Weathering and the accumulation of dust for a seed bed must have first occurred.

Another bit of evidence of great age lies in the fact that no incident of volcanic eruption has been found in the historical anecdotes of the Indian tribes of the region. And archaeologists in the Southwest present evidence that the region has been continuously inhabited for more than a thousand years.

Everything considered, it seems probable that the ice deposit has survived the torrid summers of many centuries in a land whose lack of moisture is almost proverbial.

Deposits of ice in lava beds are not particularly rare. Their occurrence, however, is seldom noted so far south as central New Mexico, (central, that is, from North to South; the deposit is not far from the Western limit of the state). On the map of the United States this spot is almost at the intersection of the parallel 35 degrees north with the meridian 108 degrees west. The elevation is a little more than 7000 feet above sea level.

How to get there

In most known ice beds which occur in lava caves the deposits melt during warm weather. Several ice deposits of continuous existence have been found near the Perpetual Ice Cave, but they are not accessible without the use of horses and resident guides. The Perpetual Ice Cave, may be visited by motorists, by following a secondary road leading southwestward from the town of Grant, New Mexico, on transcontinental highway U. S. 66. The detour moreover takes the traveler to a number of other interesting sites, including the old Spanish town of San Rafael, El Morro National Monument, the old Mormon village of Ramah, and the Indian pueblo of Zuni.

Not far from the mouth of the Perpetual Ice Cave are numerous remains of prehistoric habitations. The ruins consist of low circular walls of lava blocks, presumably primitive foundations. The identity of the builders and inhabitants never has been determined by investigators. It seems probable that proximity to an unfailing source of good drinking water—the ice cave—was justification for settling or camping in a spot where agriculture was not practical.

In this civilized age when "air conditioning" and "automatic refrigeration" have become common terms to most of us, the Perpetual Ice Cave is probably not so mysterious as it was to the primitive Indians who saw it before us.



Perpetual Ice Under Lava

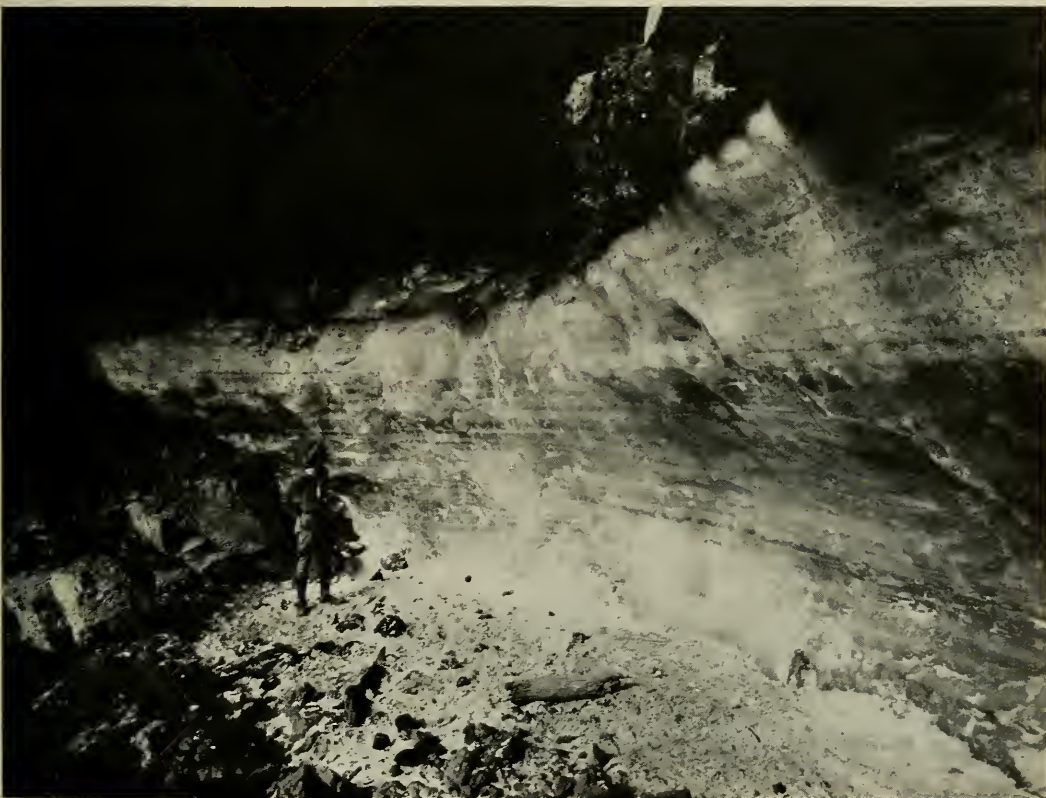
(Left) A bank of solid ice in a tunnel of what once was molten stone: a natural "ice-box" in New Mexico

(Right) The entrance to the chamber containing the ice. The air here on a summer's day is suffocatingly hot

The wall of ice is mild aquamarine in color, from 12 to 14 feet in height, and some 50 feet in width



All photos from "Frashers," Pomona, California





(Left) Maji Moto Camp in Tanganyika Territory at the foot of the Great Rift Wall: the base from which the expedition studied the animals of Africa in the interests of medical science



(Above) Mbulu natives. This tribe lived some four hours' march from camp, on the Rift plateau



(Left) A young female Thomson's gazelle captured on the plain adjacent to Lake Manyara. This animal became very friendly and was a great pet of the expedition

A Safari with a New Objective

An African expedition to search for physiological explanations of temperamental differences in animals and new knowledge on human glandular disorders

By GEORGE CRILE
and
DANIEL P. QUIRING

AN expedition to Africa sponsored by the Cleveland Clinic Foundation and the Cleveland Museum of Natural History was organized in the winter and spring of 1935, the members of the expedition leaving in the fall of that year.

Two members of the group, Dr. and Mrs. George Crile, travelled by airplane from London to Moshi in Tanganyika Territory and at Arusha, joined Mr. Arthur B. Fuller of the Cleveland Museum of Natural History and Dr. Daniel P. Quiring of Western Reserve University, who had travelled by boat from London to Mombasa.

The new objective

In preliminary studies on the size relationships of the brain, thyroid and adrenal gland, made by the Cleveland Clinic Foundation and the Cleveland Museum of Natural History in the United States, a disturbing factor had been encountered which vitiated much of the data. This was the presence of enlarged thyroid glands in many of the domestic animals and in animals secured from zoos. It was imperative, therefore, if the research were to be continued, to carry on the study in animals not afflicted by goiter or by the abnormal conditions imposed by man. This was the task with which the expedition was concerned. The richest territory in the world as far as abundance and variety of animal life are concerned is in

Africa in the vicinity of the great crater of Ngorongoro. This area, therefore, seemed to offer us the greatest opportunity for the furtherance of our research.

The selected site was a camp called Maji Moto some ninety miles west of Arusha in Tanganyika territory. This camp lies at the base of the high west escarpment of the Rift Valley about sixty miles from the great crater of Ngorongoro. It was ideal for our purpose since a great deposit of volcanic ash, the tropical sun, the abundant rainfall and the vicinity of Lake Manyara, a great soda lake, produced an abundance of plants and trees and hence of animal life.

Among the great animals

On one side of us was dense bush in which were many rhinoceros and buffalo; on another, swamp and lake in which the hippopotamus makes its home; at the foot of the escarpment was a great mimosa forest in which were herds of elephants and several species of monkeys. Between the forest and lake was a grassy plain on which zebra, impalla, kongoni, wildebeest and other herbivorous animals grazed. Feeding on these herbivora were the carnivora—lion, leopard, hyena and jackal. Various species of smaller cats (serval, genet and civet) found shelter in the forest, and all around and above us, especially in the vicinity of Lake Manyara was a great variety of bird life including vast numbers of European storks and unbelievably large gatherings of flamingoes. Locusts and other insects on the grassy plain gave sustenance to the abundant bird life.

Here we set up our laboratory and established ourselves for almost two months of intensive work. The native type of hut was used for the laboratory and for shelter as well as for the camp. The birds and smaller animals which could be easily transported were dissected in the laboratory, but the larger animals—lion, hippopotamus, rhinoceros, elephant, etc., were dissected where they fell, the various glands and tissues being taken to the laboratory for preservation and packing. Some of the smaller animals were embalmed and sent back to our laboratory at the Cleveland Clinic Foundation to be dissected there.

Many specimens

Representatives of all the true vertebrate classes with the exception of amphibia were obtained. Of a total of 220 animals, 108 dissections involving the eyes, the thyroid gland, the adrenal-autonomic complex, the brain, heart, lungs, liver and kidneys were made in the field. All these organs were weighed and examined before they were packed for shipment, and in addition in a number of animals, gastro-intestinal, muscular and skeletal weights were determined also.

The dissected animals included fishes, turtles, lizards, birds, rodents, carnivora, perissodactyls, artiodactyls, one proboscidian, hyrax, and primates. In addition to these specimens, 118 bird skins were preserved and a chimpanzee, a baboon, two gray monkeys, two vervets and two snakes—a python and a green mamba—were embalmed for dissection in Cleveland. A large amount of skeletal material was saved. In some instances, only the skull and the skin mantles were preserved; in others, the entire skeleton and skin were kept.

Back of the purpose of the expedition already briefly stated, lies the following general thesis:

Man seems to be peculiarly susceptible to certain pathological disturbances affecting the nervous system and the endocrine glands, diseases which are generally unknown in the other vertebrates. The question presents itself therefore as to whether these disturbances might be explained on the basis of possible structural differences between the nervous and endocrine mechanism of man and of the remaining backboned animals, or whether they might simply be caused by man's subjection to

a set of conditions to which as yet he has not become biologically adapted. Closely associated with this question a further one arises, namely, if structural differences exist in the endocrine-autonomic mechanism of man as compared with various animals, might this be the cause of the difference in activity patterns of the various animals, since the endocrine-nervous mechanism governs energy expenditure.

With the general acceptance of the theory of evolution, the medical and biological professions generally have stressed relationships between the various vertebrate classes, including man as a member of the primates. But a result of this tendency has been the overlooking or underemphasizing of certain other marked differences between man and his fellow creatures. The anatomist is aware that man possesses a relatively large brain, which expresses itself in superior intelligence, but he is often so fascinated by his study of structure, by the beauty of the story which unfolds itself when he proceeds from the evolutionary point of view, that he too commonly fails to consider man as a distinct problem. He does not generally look upon the organism as a dynamic energy-spending system in which the skeletal-muscular machine requires also an energy-liberating mechanism for its successful self-maintenance. While function is the true province of the physiologist, the necessary restrictions which his special field place upon him may make him generally oblivious to some of the unique characteristics of man or to the organism as a dynamic system whose various functions may be resolved into one great function—the employment and the liberation of energy.

The rôle of the thyroid

The thyroid gland governs the metabolic rate of an animal. In a highly active animal one would expect a correlation between thyroid size and bodily activity. But this is not a simple relationship, as becomes evident when an additional factor is considered, namely, body surface, which determines to a large measure the amount of energy lost as heat. In addition, the thyroid has a definite effect in sensitizing the body to adrenalin, so that the evaluation of the interrelationship of the thyroid and adrenal becomes necessary to an understanding of the true rôle of the thyroid in the body mechanism. Its secretion, thyroxin, is a definite

requisite for orderly body growth and normal mental development.

The adrenal glands have been called emergency glands since they supply the energy to meet sudden emergencies. This response is due to the activity of the medulla of the gland,* which secretes adrenalin under stimulation of the sympathetic system. The stimulation originates commonly in the sensory organs, although internal states may initiate its activity. One might expect a relatively large medulla in animals which are confronted with frequent emergencies and which depend upon sudden outbursts of energy for attack or escape.

It seemed desirable to examine this thesis by subjecting a wide range of animals to dissection and evaluation of these particular systems. Since such differences exist, they might well express themselves in relative differences in the weight of the glands or in the degree of complexity of their innervation, i.e., in the autonomic system, or in structural differences. Differences in the potency of secretions in the absence of differences in size or complexity are, of course, not excluded.

A remarkable ratio in man

The earlier studies referred to above had pointed definitely to differences in the relative sizes of the thyroid, adrenal and brain and in the complexity of the autonomic innervation of the adrenals in various animals. For instance, an examination of some 600 animals disclosed that the ratio of the adrenal to the thyroid weights in the rodents ranged from 2:1 to 12:1. In the carnivora, this ratio of adrenal to thyroid weight was $1\frac{1}{2}$:1 to 2:1. In the birds, the ratio of adrenal to thyroid weight was approximately 1.25:1 and in the primates generally the ratio ran from $1\frac{1}{2}$:1 to 6:1. It was only in man that a converse relationship was discovered, for in man alone the thyroid exceeds the adrenal in size. This relative size is expressed by the remarkable ratio of adrenal to thyroid weight of 1:2.4.

A microscopic examination and an evaluation of sections of the adrenal glands of the alligator, the lion and of man showed that in the alligator, medullary tissue makes up about 6.69 per cent of the gland while in the human adrenal the medulla makes up approximately

14.16 per cent, and in the lion the medulla makes up approximately 24.32 per cent of the gland.* Thus, if approximately 24 per cent of the lion's adrenal consists of medulla, the ratio of adrenal medulla to body weight in this animal would be as 1:22,565 in an animal weighing 190.85 Kg. with an adrenal weight of 34.64 grams. In a human being weighing 65 Kg. with an adrenal weight of 10.7 grams, the ratio of adrenal medulla to body weight is 1:54,805. In an alligator of 109 Kg. with adrenal glands weighing 5.8 grams this ratio becomes 1:280,951. While these studies were made on single glands, in each case histologic examinations of adrenal bodies from other lions, human beings and alligators, indicate that the lion generally contains a considerably larger amount of adrenal medullary tissue than does the human and certainly a vastly greater amount than does the alligator.

This, then, is the general outline of the thesis on which our investigation proceeded, together with a few of the provocative findings which made this African expedition such a promising adventure. It is not the purpose of this paper to present a detailed report of our African findings. The data are now in the process of being evaluated and will, it is hoped, be made available in due time.

Tentative conclusions

Sufficient regularity appears in our findings, however, to warrant some tentative conclusions; fuller scrutiny of the material is required to appreciate certain implications in the weight and dissectional data. The specific difference in the thyroid-adrenal ratio and in the thyroid-body ratio which appeared to exist in man as compared with other animals on the basis of our earlier work in the United States, has been confirmed so that it may be stated definitely, we believe, that man stands in a unique position with reference to these relationships. A further tentative conclusion is that the gross size of the adrenal body seems to be a function of the body mass but that the size of the medulla is further governed by the activity pattern of the animal or, conversely, the physical activity pattern of the vertebrate body is determined by the mass of the adrenal medulla. A further fact which stands out is the marked

* The cortex of the gland serves another function.

* These figures are based on approximations made with a planimeter upon sectioned glands.

difference in the complexity of the innervation of the adrenal body and the adrenal-autonomic complex in various animals. There is, of course, a definite evolution of the adrenal body and the autonomic system when one passes from the fish and the reptile to the mammals. Within the individual classes of vertebrates, however, marked differences in the degree of development of the gland and of the autonomic system occur.

We return to the question of whether man's peculiar pathological disturbances are determined by the unique relationships which exist between his thyroid gland and his body. To this one may answer that since this difference does exist between man and other vertebrates and since this gland does play the central rôle in body metabolism, it is reasonable to suppose that its frequent hyperactivity resulting in a variety of pathologic states may be due to its unique size relationship. This view receives additional support when it is considered in relation to man's peculiar biological mode of life and when the inter-play of the adrenal and thyroid glands is considered.

Activity pattern of animals

The further question which is naturally raised by our initial hypothesis is: May we ascribe differences in the activity-pattern of animals to specific differences in the degree of development of the thyroid gland, the adrenal body and the autonomic system? This may be answered affirmatively, we believe, on the basis of the mass of evidence which has accumulated in the past few years on the central rôle of the adrenal and the autonomic system in stepping-up the rate of energy expenditure, as well as on the basis of the body of evidence we are accumulating with reference to the changes in medullary size correlated generally with physical activity.

We cannot omit a word of appreciation

for the kind of coöperation given us by his Excellency Sir Harold McMichael, the Governor of Tanganyika Territory and his Staff as well as to Captain P. C. Hallier, Provincial Commissioner with headquarters in Arusha, and Captain P. Teare, Chief Game Warden for the district.

His Excellency, the Governor, granted us special permits which enabled us to secure a number of specimens which are ordinarily protected. On the basis of their extended experiences in the territory, the provincial Commissioner, P. C. Hallier and the Game Warden Captain Teare gave us much valuable information concerning the habits and the location of some of the animals we desired to secure.

We are indebted also to his Excellency P. Enen Mitchell, the Governor of Uganda Protectorate, for his kindness in granting us special permits to secure a pair of chimpanzees in the Protectorate. District Officer James at Massindi in Uganda Protectorate too was most helpful in aiding us in the completion of the necessary arrangements for the safari in the search for chimpanzees. Captain R. Salmon, Game Warden for that area also lent us the benefit of his experiences and if it had not been for these individuals, it is doubtful whether we could have secured our chimpanzees.

Captain J. R. H. Hewlett acted as our professional hunter and guide. Captain Hewlett, who has his headquarters at Moshi in Tanganyika Territory, knows the country and the game animals well. He was indefatigable in his efforts to make our expedition a success. The members of the expedition are unanimous in their feeling that one of the chief factors which made our safari such a pleasant and successful experience were the efforts of this fine personality. It is our unanimous hope that we may meet and work again with Captain Hewlett.

Outposts of Baja California

Desert islands where a vanishing fauna is making a valiant struggle to survive

By JOSEPH R. SLEVIN

*Curator of Herpetology,
California Academy of Sciences*

OFF the coast of Baja California lie a number of islands and islets harboring a vanishing fauna. The northernmost of these, Los Coronados Islets, are not far from the southern border of the United States. Others are scattered along the shore to the southward as far as Santa Margarita Island, and one group, the Revillagigedo Islands, lie almost 400 miles southwest of the tip of the peninsula.

History

It is from the missionaries that we get much of the early history of these islands. The records show that as early as 1732 Father Taraval, after a wandering journey of some six days from San Ignacio, came upon a great bight in the coastline of Baja California, which he named Bahia San Xavier. From this site he made out two islands six or seven leagues off shore, and with the aid of the Indians Father Taraval constructed a raft on which he reached them.

The nearer one, Natividad, he named Afuega, or Island of Birds, because of the great number of sea birds he found, the only living things he saw on the island. The further island, Cedros, discovered by Francisco Ulloa in 1539, was known as the Island of Fogs. Climbing a high mountain on this island Father Taraval saw to the westward the San Benito Islands, and far to the northward another island, which was undoubtedly Guadalupe.

For the naturalist who is partial to the desert these islands are particularly attractive,

their fauna and flora being so characteristic of it. Unfortunately most of those who have been lucky enough to visit them have lacked adequate time for study and exploration.

Although mostly insignificant in size, and with one or two exceptions harboring no spectacular animal life, these islands are a never-ending source of interest to the naturalist. A commercial world, however, which unfortunately knows naught but of dollars and cents and cares nothing for the future, has practically exterminated the fur seal, the sea otter, and the elephant seal. Only strict government protection and supervision can save what is left. The Mexican Government now has laws protecting the fur-bearing animals and the sea elephants, so that there is fortunately some hope of their surviving.

A tale of destruction

For the near, and in some cases complete, extermination of the land birds it is principally the commercial fisherman we have to thank. In order to facilitate their work the fishermen, especially those collecting the abalone, a valuable shell-fish, establish camps ashore, some of which are quite temporary. The custom has been to have a camp cat or two, and when the camp was abandoned these cats were left to run wild. Needless to say, having nobody to feed them, they resorted to hunting for their food, the small land birds being the first to go. Mr. A. W. Anthony, well-known ornithologist of the Pacific Coast, who became acquainted with the islands in 1887, found that on the San Benito Islands McGregor's house finch (*Carpodacus mcgregori*) had become almost extinct in a period of twenty-five years.

Guadalupe Island has been called a biologi-

cal sepulcher and is a shining example of what can happen when domestic animals are introduced and allowed to run wild. Formerly the home of numerous small land birds and described as a paradise by Edward Palmer, the first naturalist to visit it, the island now harbors only a remnant of what there used to be. The flicker, towhee, kinglet, crossbill, and Guadalupe wren have already been exterminated not to mention the Guadalupe caracara. The goat herders can rightfully be charged with the extermination of the latter bird. Claiming that it attacked the young kids, the herders methodically shot the birds as they gathered about the water holes; and it was not long before the Guadalupe caracara went the way of the great auk and the passenger pigeon. The Guadalupe petrel fell an early victim to the cats. The animals had only to wait at the mouth of a burrow for the bird to emerge bound for its feeding grounds on the high seas. Thus it was that this one-time paradise came to an end.

It is reported that many years ago a whaler, following a common custom of the early mariners, left some goats on Guadalupe Island in order to enable subsequent visitors to obtain fresh meat. While in some cases this may have been the means of saving shipwrecked sailors, it led to the destruction of the foliage, and it might be said in some cases to the island itself.

Death to vegetation

On Guadalupe the goats increased to such an extent that by about 1887 concessionaires were shipping to the mainland some 15,000 goat skins a year. They and many others later, found it to be unprofitable, however, and the goats ran unmolested, occasional droughts being their worst enemy. They have exterminated many species of plants, and only those which grow on sheer precipices will survive for any length of time. The scant forests of oaks, pines and cypress, on the tops of the northern ridges, must in time disappear. Natural causes, such as old age, storms, etc., will account for the disappearance of some of the trees but the goats in the end will take care of the rest. Even now they have the bark chewed off wherever it is within reach. No seedling is allowed to survive, and no acorn will ever mature. Thus the disappearance of the Guadalupe forests is inevitable.

About the year 1880 the Guadalupe fur seal (*Arctocephalus townsendi*) was exterminated as far as commercial hunting was concerned and for years afterwards the animals were considered extinct. It therefore created considerable excitement among naturalists when, in 1928, two fur seals were brought from Guadalupe to San Diego by some local fishermen. It is evident that a small remnant of the herd had escaped the slaughter and had hidden away in inaccessible caves unknown to the sealers and poachers.

About the south end of the island may still be seen the remains of stone huts built by the sealers, and driveways up which the animals were driven to the slaughtering ground. The rocks that were polished by countless numbers of seals passing over them in bygone ages are distinguishable, and even the pegs driven into the ground to set taut the skins for drying are still in evidence, mute reminders of the hardy adventurers of early days.

Home of the sea elephant

By far the most spectacular animal of the Baja California outposts is the sea elephant, or elephant seal, as it is sometimes called, a huge animal weighing several tons and reaching a length of twenty-two feet. These animals fell before the onslaught of the whalers who prized them highly for the oil obtained, and like the fur seal they were hunted until the exploitation was no longer profitable. These creatures fared somewhat better than the fur seal, however, and today there is a fair-sized herd (some 500 or more animals) making their home on a sand beach at the northwest end of Guadalupe Island, where they are protected by towering cliffs which make it impossible to reach them from the land side. As this shore has the whole Pacific Ocean to beat on it, it is only on the finest and calmest days that a landing can be made. This, coupled with the fact that the Mexican Government has passed stringent laws protecting the herd, may enable it to increase in years to come, so that it may once again reach its former state.

Cedros Island, one of the largest of the coastal islands, is nearly 21 miles in length and rises to a height of 3959 feet at the northern end. It is rapidly sharing the fate of Guadalupe. The abalone fishermen have found it a fertile fishing ground and have established a

camp at the southern end as their headquarters. To furnish fuel for boiling the abalones before drying them they have stripped the nearby canyons of vegetation and in their boats have gone farther afield, touching all the canyons along the eastern shore, and cutting out all the small trees. Where there were once picturesque little canyons spotted with juniper trees, which gave shelter to the native deer, there is nothing left but desolate rocky dry washes, where even a horned toad would have difficulty in finding a shady spot to escape the heat of the noonday sun.

Slaughter of deer

Serious inroads have been made on the deer to furnish meat for the abalone camp. The few that have escaped the slaughter hide out on the steep slopes of the northwest end, where a scattering of brush and trees furnishes a meager shelter. Owing to the fact that it is a long hard pull back to camp the few remaining animals may be saved for the time being; but it may be only a question of a comparatively short time before their doom is sealed.

Bird life is somewhat scarce on Cedros. Say's flycatcher, large-billed sparrow, desert sparrow, Costa's hummingbird and a few other species are represented. All visiting ornithologists have remarked about the scarcity and wildness of the small land birds on this barren and windswept island.

Leaving the coast islands and heading southwestward from Cabo San Lucas, the southernmost point of Baja California, we find two interesting islands, Socorro and Clarion, of the Revillagigedos. Socorro, the largest of the group, is a mountain peak rising out of the sea to an elevation of 3500 feet and visible at a distance of seventy miles. Its inhospitable shores must be approached with care as anchorages are poor and the winds at times strong and uncertain. The lower levels of the island are densely overgrown with brush, making traveling an arduous task. A casual observation from the deck of a vessel gives the traveler no idea what he must encounter before reaching the summit. Socorro shows signs of volcanic activity, and just below the summit are blow-holes from which steam escapes in small clouds, and hot mud flows from miniature craters.

Fortunately Socorro has not been used for fishing camps and a most interesting bird

population remains there; but now that commercial fishermen are going far afield for their fishing grounds it will only be a question of time before it meets the fate of all the coastal islands. The usual shore birds, such as the yellow-crowned night heron and the wandering tattler may be found commonly about the rocky beaches, but to see the bird life in all its variety one must climb the mountainside beyond the rank growth of brush. There the traveler emerges into a tree belt that any ornithologist would give worlds to visit. Here may be found large flocks of the beautiful Socorro parakeet feeding on the fruits of the native trees, or equally large flocks of the Socorro mourning dove, fearless at the approach of man as it walks about the ground. The Socorro red-tailed hawk may be seen soaring overhead as it searches for its prey. In short, pencil and notebook must constantly be in use in this ornithologist's paradise.

A bird of the lower levels is the Socorro elf owl (*Micropallas graysoni*), which as its name suggests is a pigmy among owls. It bears the name *graysoni* after Colonel Andrew J. Grayson, who, in the year 1867, made a private expedition to the Revillagigedo Islands and lost his vessel on the south coast of Socorro at a spot now known as Grayson's Cove, a small indentation in the coastline of Cornwallis Bay. In 1925 some of the dried out planks of his vessel, then worn almost to the thinness of shingles, were found on the rocky beach by the Expedition of the California Academy of Sciences to the Revillagigedo Islands on board the *USS Ortolan*, M. M. Nelson, Lieutenant, U. S. Navy, Commanding.

A life-saving spring

On reaching shore from the wreck Colonel Grayson's first thought was of water, the lack of which is the dread of every mariner unfortunate enough to be shipwrecked on these inhospitable shores. By good fortune a member of his crew discovered a small stream of water gushing out of a seam in the rocky cliffs. It is partly concealed by a pile of boulders, and covered by the sea at high tide, thus making it very difficult to find. It would no doubt have been taken for tide water were it not for the fact that the birds were seen drinking from it. This spring would be the only salvation for the shipwrecked mariner, at least in

the dry season, and it is so well concealed that since Grayson's discovery it had escaped detection until the Academy's expedition of 1925. Before leaving on this expedition Colonel Grayson's account of his trip was consulted, and the spring was found just as he had described it. This all-important discovery was made known to the United States Hydrographic Office, so that future Coast Pilots, or supplements, may contain this information. In order to facilitate locating the spring a large W, filled with white cement, was carved in the rock, with an arrow pointing to the water and an inscription.

Fortunately for Colonel Grayson he "picked" a particularly nice place to be wrecked, for aside from having the spring at hand, the back of the beach was covered with a thick growth of trees, giving both shade and firewood. If he had tried all the beaches on the island he could not have found a better one. The adjacent waters abound in fish and there are plenty of sheep, in a half-wild state, scattered over the island from the seashore clear to the summit.

The original stock is said to have been placed on the island, in 1869, by John Smith, who obtained authority from the Mexican Government to make use of it as a commercial venture. He also introduced some twenty-five head of cattle, but most of these died and the remainder were killed for meat. The sheep fared better and multiplied considerably, notwithstanding the intense heat and the rough character of the country.

Isolated island fares better

Less visited than Socorro on account of its isolated position some two hundred and fourteen miles to the westward is Clarion Island. Although much smaller than Socorro it is interesting because it is seldom visited and the fauna and flora still remain in their natural state. The tameness of the birds reminds one of the far-off Galápagos. The little ground owls can be approached and chucked under the chin without their showing the slightest fear.

Great numbers of sea birds make Clarion a nesting site, and boobies, frigate birds, tropic birds, and the usual shore birds, such as curlew plovers, turnstones and great blue herons, are found along the coastline. One striking feature of the fauna of the island is a large reddish-brown snake (*Coluber anthonyi*) re-

sembling the red racer of our southern deserts. They are found abundantly about the *Opuntia* patches, and it may be safe to say that Clarion Island is one place where you can go ashore and be sure of finding plenty of snakes. How they reached the island is a problem yet to be solved. It is a significant fact, however, that no snakes have ever been found on the neighboring island of Socorro, much nearer to the mainland.

Every visitor to Clarion remarks about the wonderful growth of cactus covering the southern slopes of the island. A great carpet of *Opuntia* spreads over the landscape and it is only in the thinner areas that it is possible to get through, and then only with the aid of a machete. To make things more interesting the top of the cactus growth is covered in many places with a carpet of morning-glory vines, forming an impenetrable tangle. The northern slopes of the island offer quite a different aspect, being fairly open and covered here and there with patches of long grass. In these nest thousands of Townsend's shearwaters (*Puffinus auricularis*), their burrows honeycombing the hillside so that in certain areas walking is somewhat of a problem.

Wild life demands protection

Now that fishing vessels go great distances out to sea in quest of the deep sea fishes it may only be a question of time before Clarion meets the fate of the coastal islands. Only its poor anchorage and the lack of suitable landing places may help to postpone the destruction of this interesting fauna. Sulphur Bay, the only anchorage, is an open roadstead and affords poor shelter, being exposed to all southerly winds. The landing place, in a small cove to the westward, is dangerous even in calm weather on account of the unexpected swells that roll in from an apparently calm sea, and a vessel may anchor for days, or even weeks, without being able to put a landing party ashore.

If the Government of Mexico can enforce the laws protecting the wild life of these islands there may be some hope of saving the fur seal and the sea elephant from extinction; but the land birds will have a difficult time to survive. The disappearance of the wild life of any land is regrettable, and it is slowly but surely happening here.

Outposts of Baja California



(Above) A scene on barren, windswept Cedros Island, one of the "outposts" off the coast of Mexico. At the top of the ridge can be seen a straggling pine forest, while below it is a scattering of dwarf juniper trees

*Photos by G. Dallas Hanna,
California Academy of Sciences*

The above photograph shows a grotesque elephant tree which stands as a sentinel on a rocky promontory of Cedros. The beautiful pink flowers of these trees when in bloom lend almost the only touch of color to the island

(Right) Frigate birds are abundant on many of Baja California's outposts and San Benedicto Island is no exception. The inflated crimson pouches of the males on the nests make the ground appear as though covered with a great red blanket





A herd of sea lions on the San Benito Islands. Formerly the sea elephant, sea otter, and fur seal made these three small rocky islands their home, but the fur bearers are gone and all that remain are the sea lions and occasionally a few visiting sea elephants from the Guadalupe herd (Photo by W. Chas. Swett, Courtesy of the G. Allan Hancock Expeditions)

(Right) Drying abalones on West San Benito Island. The use of diving suits by the Japanese fishermen and the indiscriminate gathering of the abalone, regardless of size, will in time result in its destruction

*Photos by G. Dallas Hanna,
California Academy of Sciences*

(Below) Where the sealers once carried on their trade: at Melpomene Cove, Guadalupe Island. The derelict dory shown in this picture might tell a story if it could speak, but nothing was found to indicate from where it had come



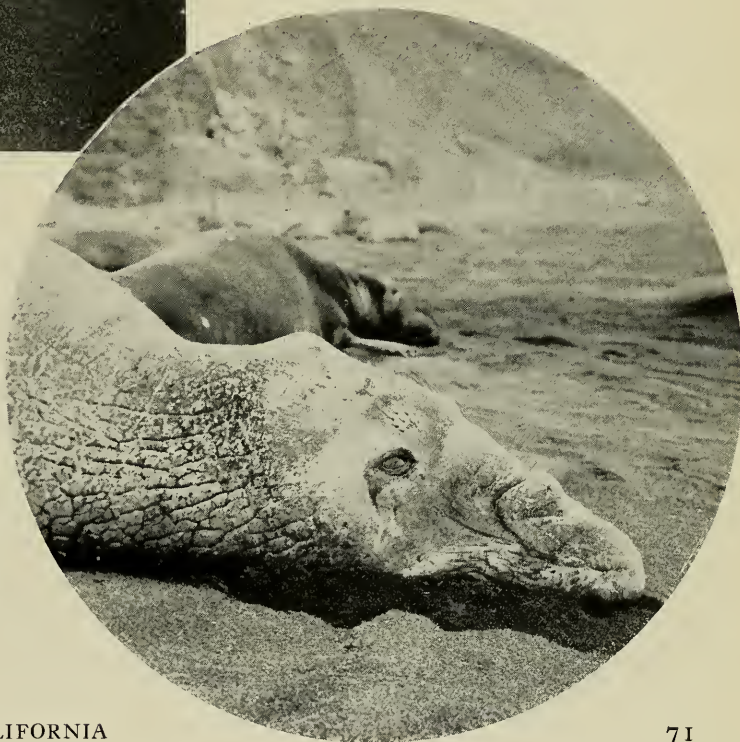


It is possible to walk amongst the sea elephants at Guadalupe Island without disturbing them in the least—after you have landed. But natural obstacles make this beach well-nigh inaccessible (Photo by W. Chas. Swett, Courtesy of G. Allan Hancock Expeditions)



(Left) The sea elephant knows how to relax, and although this one may appear lifeless, such is by no means the case

*Photo by G. Dallas Hanna,
California Academy of Sciences*



(Right) The head of a basking sea elephant: not a thing of beauty but a curious looking creature to say the least (Photo by W. Chas. Swett, Courtesy of G. Allan Hancock Expeditions)



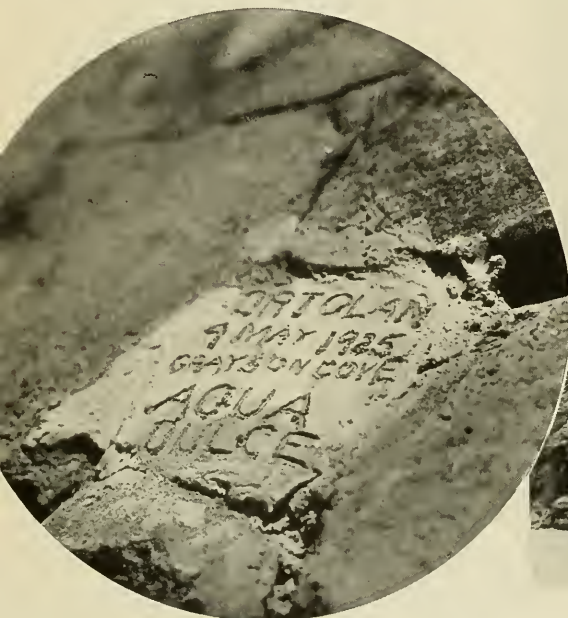
(Above) Cabo San Lucas, at the southern tip of Baja California, is a famous headland and a useful landmark for all passing vessels

(Left) Grayson's Cove on Clarion Island where a spring of fresh water saved the lives of Colonel Grayson and his crew when shipwrecked a half century ago

Below) The cement plaque left by the U.S.S. Ortolan to direct mariners in emergency to the spring

(Lower right) Monument Rock, one of the prominent landmarks off the coast of Clarion Island

Photos by G. Dallas Hanna,
California Academy of Sciences





Photos by W. Chas. Swett, Courtesy of the G. Allan Hancock Expeditions



(Above) Sea elephants under observation on the beach of San Benito Islands. The sea elephant is the most spectacular animal of these outpost islands. The Mexican Government's stringent laws may enable it to increase to its former abundance

(Above) A large bull sea elephant poses for his portrait. These creatures weigh several tons and reach a length of twenty-two feet

Two Scenes at Fallodon



(Above) The larger of the two ponds on the estate of the late Lord Grey, where over twenty species of wild ducks make their home.

In the lower picture Lord Grey is seen seated at the side of this pond feeding an

an absence of seventeen months returned and fed from his hand the day of its arrival. From this side one looks across the pond to Fallodon as shown in the upper picture.

These two photographs are reproduced from an article by Lord Grey in the September-October, 1932, issue of NATURAL HISTORY



Memorials to Lord Grey

Plans to perpetuate the ideals of a man who strove for international harmony and a broader appreciation of Nature

THE General Committee of 69 formed in England to create a memorial to the late Viscount Grey of Fallodon has issued an appeal for support which, in a few words, admirably states its objects. It reads:

"Lord Grey is remembered as the statesman who fought so long and so hard the losing battle for European peace; and who, amid the blinding passions of war, with failing health and eyesight, never lost his mental vision of two main principles of his practical idealism, the necessity of friendship between the British Empire and the United States, and the necessity of some collective security for future peace, which from the first he strove to see embodied in a League of Nations.

"He is remembered also as the lover of nature. In writings that combine the poetry and the science of bird observation, he has taught many to find the purest and most lasting joys of mind and heart.

In public and private life

"Yet the two aspects of his life are not to be dissociated. If the strength, integrity and simplicity of his character made him for eleven years the notable representative of his country before the world as Foreign Secretary, and helped to give to the British Empire and her Allies confidence and unity at the supreme crisis of fate, these qualities were drawn from the same well-springs of old English rural life which inspired him as a countryman, a naturalist and an author.

"We therefore propose to erect to his memory a threefold memorial:

"1. To set up a statue or bust in a central spot in London.

"2. To acquire and make over to the National

Trust 'Ross Castle', the small hill-top crowned by an ancient earthwork which adjoins Chillingham Park in Northumberland, a favourite view-point of Lord Grey's which he often visited from Fallodon.

"3. To develop (by further endowment and otherwise) the existing scheme of research maintained by the British Trust for Ornithology at Oxford, of which University he was an undergraduate and in later years the Chancellor, to form a permanent Institute of Bird Studies, to which his name would be attached."*

The bond among nature-lovers

It is the last-named object that will most strongly appeal to those who will welcome an opportunity to pay their tribute to the memory of Lord Grey. Busts and "National Trusts" have their places, but this plan to form a living memorial which, we may assume, would not only increase our knowledge of birds but would aid in promoting that relation between birds and man, the value of which was so eloquently demonstrated by Lord Grey himself, transcends in its importance all national bounds and concerns nature-lovers throughout the world. We can readily imagine bird students of other nations seeking instruction at Oxford, and as the success of the "Edward Grey Institute of Bird Studies" becomes apparent, who can doubt that similar Institutes will become a part of other centers of learning? Here is the foundation of a League of Nations which might assure at least a bird protection under whatever flag it happened to find itself.

It may also be assumed that among the textbooks used by this proposed Institute a high place would be accorded Lord Grey's "Charm of Birds." While this work is dedi-

* Subscriptions to the memorial fund payable to J. P. Morgan & Company, may be sent to that firm at 23 Wall Street, New York City, who will remit them to the Barclay Bank, agents of the Memorial Committee in London.

cated chiefly to English passerine birds, their appearance and personalities, their place in nature and in literature, their association with the seasons, and especially their voices, it also records, with convincing enjoyment and wholesome sentiment, the value of birds as an expression of their environment.

Read, for example, what the "robust, buoyant" song of the chaffinch meant to its author. "If the chaffinch were human," he writes, "one can imagine that he would say 'Cheerio!' as a greeting to a friend. . . . One chaffinch stands out in my memory as does a single dipper and a single wren. It was in the Whitsuntide recess, when for a few precious days late in May or early in June I had escaped from Parliament and from London, whose 'season' is then so miserably unseasonable. The days were fine and bright. On a stone coping of a little parapet, that went around the roof at Fallodon, at a corner that faced due south, a chaffinch used to take its stand, and from that eminence pelted me with song whenever I went on the lawn outside. This one bird became a feature of the holiday, an embodiment of happiness proclaimed from the housetop. . . . For me the immortal spirit of those happy Whitsuntide days still lingers in the song of the chaffinch."

The whole book abounds in similar responses to the song and personality of birds. I quote once more to show how varied and far-

reaching was their influence in Lord Grey's life. Wild ducks were the distinctive birds at Fallodon. Lord Grey had introduced over twenty species and from one to two hundred unpinioned birds were free to go and come. After describing graphically the early morning play of a group of these birds on the larger of his two ponds, as seen from a bench at the pond-side, he writes:

"All was quiet; there was no sound or stir; the water was again smooth, the reflections in it were composed once more; the sun still shone; on the water and the birds; on the scarlet-barked willows and the delicate bareness of winter trees on the opposite side. Any one who had come upon it now might have thought that the place was under some spell. He would have seen the man on the seat sit motionless, too, for a long time; entranced rather than asleep; the scene had indeed sunk down into his heart and 'held it like a dream.' There are times when man's consciousness seems laid to rest in some great whole, of which he has become a part. There are hours of which it can be said, 'Thought was not: in enjoyment it expired.' So it was now, and if anything stirred in the mind at all, it was an echo of the words, 'And God saw that it was good.'"

FRANK M. CHAPMAN,

*Curator of Birds, American
Museum of Natural History*



A scene from the Roosevelt-Grey Walk in the New Forest in Southern England, reproduced in the American Museum habitat group, which is dedicated to the memory of Viscount Grey of Fallodon

Diving Spiders

Intimate observations on a spider of India which submerges when frightened or in search of food, and preys upon fishes

By GOPAL CHANDRA BHATTACHARYA

*Bose Research Institute,
Calcutta*

FAMILIAR with the rapid manner in which spiders move on land and with their web-spinning maneuvers in the air, many people do not realize that certain varieties have also attained astonishing mastery in the realm of water. To see them leap here and there on the surface of a river or lake is in itself a surprising sight, but most fascinating of all, perhaps, is their habit of submerging and remaining under water for considerable periods. Some are able even to prey upon small fishes.

A spider of this sort is *Lycosa annandalai*, whose activities it has been my fortune to observe in the neighborhood of Calcutta. I came across the specimens I am about to describe quite unexpectedly.

Searching for stick-spiders

I was strolling through the suburbs of Calcutta in the month of March when I came upon a stagnant pool. Though the center was quite clear of weeds, its shores were completely overgrown with aquatic plants and grasses of various kinds. Around the edges the big green leaves of the *Colocasia* drooped over the surface of the water. These plants were the abode of another variety of spiders, the red-brown and spotted black stick-spiders of the genus *Tetragnatha*.

These spiders, with the purpose of preying upon various minute insects that hover or walk upon the surface of the water, attach themselves to the leaves, stems, or stalks of the *Colocasia*, where they may easily be mistaken for dead sticks.

I was trying, in vain, to capture some of

these interesting creatures when my attention was drawn to a well developed stick-spider, which was passing from one plant to another. As the water was only knee-deep, I tried to catch it, but as I reached out, the spider, detecting danger, leaped with great alacrity upon the surface of the water. Immediately a big gray spider, with spotted back, came running from an adjacent leaf of *Nymphoides* (*Limnanthemum nymphoides*) and jumped upon the poor creature in the twinkling of an eye. The victim struggled, only to expire within a minute and a half. The aggressor then dragged the dead animal to a blade of grass and began feeding on it.

A chase

I resolved to capture the creature that had made the attack. But as I approached, it jumped and ran away; and I eventually lost sight of it entirely among the grasses that stood out of the water. I splashed the water and disturbed the vegetation sufficiently to cause several others of different sizes and shapes to come out on the surface of the water. Greatly alarmed, they began to run hither and thither.

I singled out another specimen and pursued it relentlessly. Soon the creature became tired and ran no more, but folded all its legs and crumpled itself into a mere mass, resembling something dead. This black mass was floating in an inverted position on the water by the side of some *Nymphoid* leaves. The instant I placed my fingers on it to pick it up, to my utter surprise it disappeared suddenly and completely, where, I could not follow. I had been quite close upon the creature, but I could not detect the secret of its escape.

For perhaps a quarter of an hour I searched in vain. Thoroughly disappointed, I was about

to give up the chase when suddenly just to my right, I saw a big spider emerge from beneath the water. The mystery of their hiding themselves so quickly was then solved. This large specimen with grayish-black back and bluish-white lines around the cephalothorax, had been lurking below the surface. I had had no idea that these spiders could dive under water, like otters and beavers. Since discovering this, I have scarcely ever failed in capturing them.

When frightened, they suddenly submerge and remain clinging to the aquatic plants; and I have often seen them stay below for more than twenty minutes. Because of an air film surrounding their bodies, they look silvery white under water. The coating of air prevents the water from moistening them. The mother spider, carrying a cocoon from which young will eventually emerge, dives under water in a similar manner and under similar circumstances.

The depth to which the spider dives is usually several inches, and if pursued, it creeps for a considerable distance under water along the aquatic plants and tries to hide itself in a place of safety. When exhausted and unsuccessful at concealing itself, it feigns death, folding all its legs and floating on the surface of the water in an inverted position.

In some respects, both the males and females are of similar habits and frequent the same places. But the males keep at a safe distance from the females, lest they be attacked by them. Though smaller in size, the males are more formidable looking and run more swiftly than the females.

Courtship

In the breeding season, the male idles here and there over the leaves or stalks of plants and grasses, or in bushes in search of a mate; while the female sits quietly under a bush or upon a leaf. When a male meets a female both remain stationary for some time. If the female moves, the male follows her keeping at a safe distance. If the female faces about, the male remains motionless as if dead. Presently the real courting begins and the entire operation takes a considerable time.

The observations I shall recount began about eight o'clock one morning at the edge of a stagnant pool at Kankurgachhi near Calcutta. I was squatting on a moist patch of land, when

my attention was drawn to a small slender spider, which was moving in a peculiar dancing manner, repeatedly entering and leaving a small clump of aquatic plants and sometimes encircling the spot. It was not until later that I learned that his intended mate was lurking there. The male would advance toward the spot with very slow and cautious steps, counting paces as it were. He would raise his body to the maximum height and lower it again with a graceful movement of the pedipalpi, paying as it were homage to her majesty, with his head bowed down and both the pedipalpi folded. The pedipalpi were prominent and black, with femur and patella dorsally ornamented with bluish-white soft bristles.

Female larger

After a while, the spider advanced toward the bush, spreading his fore legs upward. Without stirring an inch from my place, but peeping through the plants, I saw what was happening inside. The female spider, much larger than the male, was resting on a floating Nymphoid leaf. When the male approached her, she raised her fore legs and chased him. The male kept quiet for a few minutes and then again approached her, dancing vigorously and vibrating his legs. If he appeared to be lacking in proper enthusiasm, the female would try to rekindle his interest by vibrating her hind or fore legs. The same procedure was repeated several times. Then, while the female still lay in ambush, the male, all of a sudden, approached her and clutched her tightly.

The preliminary dancing as I later learned sometimes lasts for hours; and the actual mating, in this case, continued for more than fifteen minutes. During this time, I managed to confine the pair, without disturbing them, in a glass tube. When the male released the female he remained motionless for a moment, then ran toward the end of the tube. Being unable to escape, he came back a few paces. Thereupon the female rushed upon her recent mate, caught him and stuck her fangs right through the cephalothorax. The poor animal died in a minute or two.

If one were to judge from her appearance and movements, the female was extremely furious. A few minutes later I introduced another male into the tube and the same lot befell it.

The female was kept in captivity, and after sixteen days she laid her eggs and encased them in a pea-like cocoon. It is curious that this specimen and all the others of various species that were kept in captivity, invariably laid their eggs at night. The mother spider under discussion firmly fixed the pea-like cocoon to her spinnerets and carried it continuously until the young were hatched, fifteen days later. Immediately upon emerging from the egg-sac, the young spiders, numbering 167 in all, got upon their mother's back.

Tenacious instinct

Once I detached the cocoon from the mother's spinnerets and put it at a distance. But the mother would not be separated from it. She attached it again to her spinnerets as often as I removed it. I pinned the cocoon to a lump of paraffin. The mother tried her utmost to snatch it away, and having failed attached her spinnerets to it and sat upon it. In this position no menaces would cause her to forsake her instinctive duty of guarding the egg-sac.

A mother spider cannot distinguish, however, between her own and another spider's cocoon. When her own cocoon was exchanged for that of a different species, the spider was quite satisfied with the substituted one. Several different cocoons, nearly of equal size, were mixed up. The mother spider was unable to recognize her own and was satisfied with whichever one she happened to pick up. It has also been observed that if an extra cocoon is offered, the spider will sometimes carry it with the side legs.

These amphibian spiders spend most of their time floating on water or resting upon leaves or stems of aquatic plants. But with the approach of evening they usually retire to land and seek shelter under cover of nearby vegetation. Sometimes they climb upon the leaves or stalks of grasses or creep under bricks and pebbles or into holes in the earth and rest there for the night. I could find no evidence of any

retreat or resting place made by the spiders themselves either on land or in water. They are not regular weavers of webs or anything resembling them, but only spin a little for their cocoons. They are very quarrelsome. If a male or female happens to be in close proximity to another male or female a serious quarrel is inevitable. The duel ends in loss of legs, endangering the life of either or both of them.

The female lays eggs in a cocoon of a deep olive color, ornamented with several white spots. The cocoon is composed of two hemispherical cups of silk, joined together with loosely bound white web material, making a line along the equatorial region. With the gradual development of the eggs inside, this white band widens till it gives way for the exit of the young spiders. After coming out of the cocoon the young spiders flock into their mother's back and remain there for five or six days. These young ones are always in danger of their lives, for neighboring older spiders invariably kill them whenever they catch sight of them.

Fish hunters

Though they are of cannibalistic habit, these spiders prey principally upon the water-flies that float upon the surface of the water, the smaller dragon-flies, etc.; and they even hunt small fishes whenever there is opportunity.¹ After seizing their prey, they suck the juice out of it by inserting the fangs and crushing the victim with the powerful mandibles.

Sometimes they rest upon the clear surface of water, making little depression on the surface. They cannot walk slowly upon the water surface but cover wide stretches of water by quick jumps. But their most interesting activities are their maneuvers under water. These spiders, which have been identified as *Lycosa annandalai*, are only one of a number of kinds which have mastered in greater or less degree the aquatic medium, and provide a rewarding subject of observation for the naturalist.

¹The activities of spiders as fishermen have been described by O. Lloyd Meehan in *Natural History* for October, 1934, and by Dr. E. W. Gudger in *Natural History* for January-February, 1931, and in earlier issues.

Diving

(Left) An interesting spider of India in a typical posture: *Lycosa annandalai* which displays underwater tactics even more fascinating than the aerial maneuvers of the common varieties with which we are all familiar



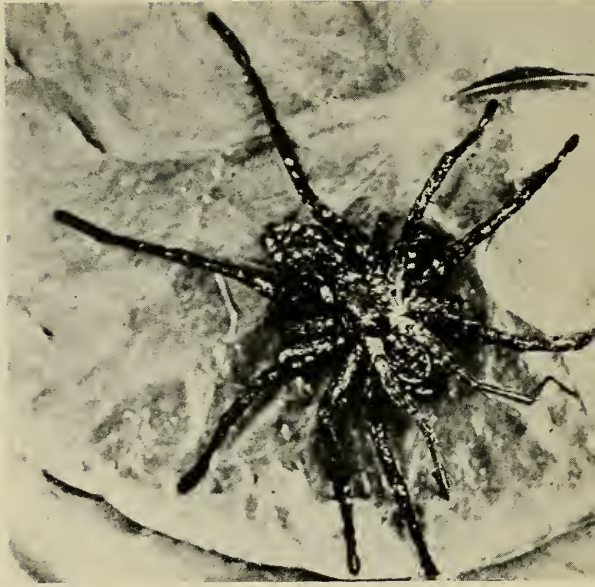
(Above) A spider with a true fish-story to tell. Although these spiders prey principally on insects, they also capture and devour small fish, from which they extract the juice by inserting their fangs and crushing the victim with their mandibles



(Left) This spider is using the leaf of a water plant as a float from which to carry on his predatory activities. He searches the surface for water-flies and dives in quest of fish, remaining submerged for as long as twenty minutes

Spiders

(Right) *The mating of Lycosa annandalai. The female was kept in captivity and after sixteen days laid her eggs and encased them in a pea-like cocoon. She would not allow this egg-sac to be separated from her during the fifteen days that preceded the hatching of her young*



In the above photograph the male is shown courting the female, which is the larger of the species. He approaches with slow and cautious steps, as though paying homage to her majesty. In the end the female kills her mate

(Right) *A group of the spiders in their natural setting: males and females resting on Nymphoid leaves. At the lower right a mother is carrying her young ones, while at upper left and below, each spider has captured a fish*



Science in the Field and in the Laboratory

Dedication of African Hall—Russian Eclipse Expedition—Meetings of Societies—City Bird Classes

African Hall Is Open

The dedication and opening of Akeley Memorial African Hall on May 19th was an event which many members have eagerly awaited.

The ceremonies were held in the Entrance Hall of the New York State Theodore Roosevelt Memorial, which adjoins African Hall. President F. Trubee Davison of the Museum presided before a large gathering of members and friends of the Museum and spoke on the distinctive features of this great exhibit. He gave acknowledgment to the various persons instrumental in the creation of the Hall and expressed the pride which all who have participated in it must feel in inviting the public to behold Africa, not as this or that person imagined it, but as it is.

President Davison introduced Mrs. Mary L. Jobe Akeley, who has been a vital force in the carrying out of the great dream which her husband did not live to see. Mrs. Akeley expressed her feelings in a brief paper, which because she was suffering from laryngitis, was read by Dr. Harold Anthony. Doctor Anthony, in turn, explained how the American Museum of Natural History has been a pioneer in the habitat method of exhibiting mounted animals, and pointed to African Hall as a climax in the development of museum art. He also described briefly the groups in African Hall and called attention to the precision that has been exercised throughout to preserve the effect of reality.

Dr. James L. Clark, who has been responsible for the entire preparational work connected with the Hall, was unfortunately absent from the ceremonies on a Museum expedition to Indo-China.

The great dream which Carl Akeley had of bringing Africa to America first stirred in him about a quarter of a century ago. When the dream was crystallized an African Hall Committee was formed on which Daniel E. Pomeroy has served continuously as Chairman. Mr. Pomeroy spoke at the ceremonies on the greatness of Carl Akeley from the point of view of an intimate friend.

Readers of NATURAL HISTORY are reminded of the January, 1936 issue of the magazine which was devoted to African Hall. Now open to the public, this superb display will acquaint thousands who

might never otherwise see it with the wild beauty of Africa.

Doctor Fisher to View Russian Eclipse

On May 16th Dr. Clyde Fisher, Curator of the Hayden Planetarium, sailed on the Swedish-American liner *Drottningholm* for the first lap of his journey to Russia and Siberia. Doctor Fisher, as a member of the Harvard College Observatory Expedition, will take photographs and motion pictures of the total eclipse of the sun which occurs on June 19th, and which may be observed to the best advantage from the little hamlet in eastern Russia by the name of Ak-boulak. This eclipse will not be visible in the United States. While this total eclipse is an important phenomenon of great interest to astronomers in the study of the sun, it does not overshadow the second objective of Doctor Fisher's trip, which calls for a study of the great meteor craters in northwestern Siberia.

The Hayden Planetarium

During the month of June "The Midnight Sun" will be the subject of the lecture in the Hayden Planetarium. The demonstration will include a trip to the North Pole with several stops on the way to observe changing conditions as the latitude changes. The midnight sun and its apparent motions will be visible from the Arctic regions, as will also that beautiful spectacle, the aurora borealis or northern lights.

Amateur Astronomers Association

The Annual Meeting of the Amateur Astronomers Association on May 20th brought to a close the regular lecture-meetings for the season. The next regular meeting of the Association will be held on October 7th, after which lectures will be given on the first and third Wednesdays of each month. Members of the Association are hoping for fine weather and clear nights this summer. Trips are planned to astronomical observatories to examine observatory equipment, and, when possible, to look through large telescopes; other trips are to points on the outskirts of New York City for constellation study. These field trips begin with a visit

to the Naval Observatory in Washington, D. C., on Memorial Day. All persons interested in obtaining notices of and further information about these amateur expeditions are invited to address the Secretary of the Amateur Astronomers Association at the American Museum of Natural History in New York City.

Junior Astronomy Club

Although the season of the Junior Astronomy Club was formally closed at a Jubilee meeting on May 9th, various activities will continue throughout the summer. The club is making a survey of the plans of numerous observatories for observation of the eclipse of June 8, 1937. This unusual eclipse will have a seven minute period of totality and will be unequalled for a thousand years except for the eclipse of 1955.

Meteors, variable stars, and other sky phenomena will be watched by members who will pursue their individual observations during the summer months.

Close Neighbors of the Earth

Between the orbits of Mars and Jupiter there is a belt of tiny planets called minor planets or asteroids. The total number of asteroids has been estimated at between 40,000 and 50,000. All of those observed go around the sun in the same direction as that in which the major planets move.

The astronomical world was interested in the discovery in 1898 of a small member of this group,

which approached nearer the earth than Mars, and even nearer than Venus, which comes within 26,000,000 miles of the earth. This asteroid was named "Eros"; its diameter was estimated at 20 miles; and on account of the great eccentricity of the orbit, it was found to come within less than 14,000,000 miles of the earth. The orbit of this asteroid proved to be an improved yardstick in measuring the distance of the sun from the earth.

For more than a third of a century, Eros was the most neighborly of the known planets. But in March, 1932, an asteroid was discovered by Delporte of the Royal Observatory at Brussels, and later named "Amor," which is hardly more than 10,000,000 miles beyond the orbit of the earth at its closest approach. It is estimated to be not more than a mile or two in diameter.

In April, 1932, an asteroid was discovered at Heidelberg by Reinmuth, which approaches much closer to the earth than Amor. It is only about a mile in diameter, and at two points its path comes within three million miles of the earth's orbit.

In February, 1936, Delporte discovered an asteroid only about one-third of a mile in diameter, and consequently no bigger than a mountain on the earth. In fact, the asteroids in general have been referred to as "flying mountains." This tiny planet came within 1,500,000 miles of the earth, and is therefore our nearest known celestial neighbor except the moon and the meteors. After charting its path, Delporte named this newly discovered minor planet "Anteros," the mythological brother of Eros.



Early morning bird class of the American Museum of Natural History studying a northern water thrush in Central Park, May 12

To the nature-loving New Yorker who is city-bound in the awakening months of April and May, Central Park offers surprising opportunities for study and recreation. To the expert, 100 spring species seen in the course of a month on two early morning rambles a week in Central Park may not seem especially significant, but to the New Yorker who longs to get to the country and cannot, it is thrilling.

The American Museum of Natural History, realizing the general interest in birds and the fine opportunities for study at hand in the Park, has been sponsoring, for the past five years, early morning walks during the migration season. To be greeted the middle of April by phoebes, robins, juncos, and even cowbirds after a long, cold winter is delightful. By this time, too, "Silver-tail," the albino grackle, is back to make his third yearly nest, and a flicker is loudly cuh-cuhing his approval of a maple to his mate for household purposes. Hermit thrushes, goldfinches, rusty blackbirds, and all too rarely a cardinal add their sweet voices to the middle April chorus. And on one dark morning a hump on a horizontal limb suddenly came to life in the form of a whip-poor-will. The sight of this bird, so seldom seen in the Park, was a real treat to the early birders.

One young enthusiast took to surprising the group with some pre-class discoveries. One morning he had spotted a yellow-bellied sapsucker at work and promptly led the group to the bitternut tree. The sapsucker, meanwhile, had disappeared and one student remarked that perhaps he had found the sap as bitter as the nut, but an even row of deep, little dripping holes in the trunk told the tale. Then some quick eyes spied him busily drilling at a neighboring tree, when we found that breakfast to a woodpecker came foremost on a chill morning, regardless of any curious lot of binocular devotees.

Last year two little screech owls chose an old pine near the West 77th Street entrance to the Park for their sleeping quarters. Upon first sight they looked like a knot on the rough bark, and the class was agog when they raised their heads and opened their large, sleepy eyes. Their admirers stop regularly this year to scrutinize the old pine, but so far without success. That is what makes birding so fascinating—the unexpected finds, the reunion with old bird friends, and the uncertainty of what may be in the next tree or around the corner.

As the migration season advances, birds come in a bewildering profusion. This spring a warm, south wind in the third week of April brought the first wave of warblers, golden-crowned and ruby-crowned kinglets, purple finches, blue-headed vireos, and others. Seeing thirteen species for the first time within an hour delighted the older students, whereas it dazed the beginners. In a month's time those seeking rarer species had heard the Cape May warbler sing his weak little song and the Tennessee warbler give his distinct "strident chattering." Some of the beginners had 75 life species to their credit—enough to keep them busy learning their habits the rest of the summer.

Although rare species of birds may still be seen

in the Park, if there were more underbrush, soft earth, and green grass, as in former years, it is probable that many more would linger and rest in this city refuge while migrating. All New Yorkers who love birds and count them as their city friends should do their utmost to protect and improve the Park, to discourage vandalism, and to encourage and support the several sanctuaries that have been established.—GLADYS GORDON FRY.

Meeting of the American Association of Museums

The Thirty-first Annual Meeting of the American Association of Museums was held in New York from May 11th to May 13th. On Tuesday, May 12th, the members of the Association were the guests of the American Museum of Natural History. In the morning a general session was held in the Theodore Roosevelt Memorial Auditorium, at which President F. Trubee Davison presided and greeted the delegates. At noon the trustees of the Museum tendered a luncheon to the delegates, and in the afternoon section-meetings were held in the classrooms of the School Service building. Some 400 were present.

Annual Dinner

The Annual Dinner of the American Association of Museums was the last event of the meeting and was held on the evening of May 13th in The Hotel Roosevelt. John H. Finley, associate editor of the *New York Times*, served as toastmaster and introduced the speakers, who included the following: Robert Cushman Murphy, of the American Museum of Natural History; Louis Cons, professor of French literature, Columbia University; and Vilhjalmur Stefansson, arctic explorer.

Doctor Murphy addressed the gathering of about 300 members and guests on the modern trends in museum aims: "Thirty years ago," he stated, "the museum idea had not . . . gone so far into the out-of-doors, much less into waves that travel around the earth via the stratosphere. . . . As I remember, many of the papers at the earliest meetings of this organization related to standardization of methods and equipment, a tendency which would have become the very bane of museums—institutions which must be individualistic and distinctive, if nothing else. What a revelation we have had this week in such more exciting titles as: 'The Film as a Museum Piece,' 'Showmanship in the Museum,' 'Research Service in the Museum Library,' 'Air Conditioning,' 'Infra-Red Photography,' and 'Objectives of Museum Work in National and State Parks.' . . . During the course of one short generation the whole museum idea has burst out from between the walls of discrete compartments, and from under solid roofs, and has entered the schools, camps, homes, even the forests, deserts, shores, and canyons of the wide world. Contrariwise, vastly more of the out-of-doors has been brought into the museums, so that indoors and outdoors are inextricably interwoven."

Doctor Murphy also pointed out some of the obstacles to the conservation of our national fauna and flora: "The settlers of our country were not

originally woodsmen. They were husbandmen, traders, manufacturers, and they had been so for a thousand years in their old home. . . . These forbears of ours suffered, in short, from the fallacy of the inexhaustible. If forests were laid low, there were plenty more just beyond. . . .

"... We are still largely possessed of a Yankee mania for drainage, which has been one of the most devilish of all our national habits. In the British Isles, as elsewhere in Europe, a marsh is treasured by any community, large or small. It is the place where the first spring blossoms emerge, and where gray herons, moorhens and waterfowl become almost as familiar and confident as barnyard birds. But in our own country the point of view of the 'realtor' has become so nearly controlling that most Americans look at a moist area filled with green rushes, meadow orchises, and pond lilies as something to be filled as promptly as possible with ashes, tin cans, and bedsprings. . . .

"But . . . we [in the museums] are not confined to the ordinary channels either of legalistic means or of scholastic education, and we well know that public opinion is far more effective than law."

The Fate of Grand Lake

In Rocky Mountain National Park, which was set aside in order to preserve in the National Park System a fragment of the most beautiful section of the Rockies, lies Grand Lake, the largest and loveliest lake in Colorado. But that beauty, and the existence of a large part of the present animal and plant population of the region is menaced by the proposition, now before the House of Representatives, to carry through the so-called Grand Lake—Big Thompson Transmountain Diversion Project. As outlined in hearings in the Senate, the plan provides for diverting water from the Colorado River in the southwestern corner of Rocky Mountain National Park through a tunnel under the continental divide into the Big Thompson drainage by a dam 190 feet high across a narrow gorge in the Colorado River. The Granby Reservoir, with 380,000 acre feet capacity, would be built at a cost of \$1,370,000. The enlarged Grand Lake would be connected by a tunnel 68,700 feet long, nine feet in diameter, to cost \$5,134,400. (Incidentally the estimate for the Moffat Tunnel was \$6,000,000 and the actual cost \$18,000,000.)

The cost of the entire project, including supply canals and a power plant, is estimated at \$22,000,000. The water would be used to supplement existing irrigation systems which supply sugar beet areas now under cultivation.

Grand Lake will be ruined if this project is authorized, according to a letter received by Dr. H. E. Anthony from the American Planning and Civic Association, which points out that "the enormous amount of debris would undoubtedly create unsightly conditions of the worst sort near Grand Lake at the west side end of the tunnel and in the Park at the east end. See the entrance to Moffat Tunnel. The 8000 feet of conduit from the end of

the tunnel to the east park line would introduce unsightly conditions which would last for many years and might never be obliterated."

The American Indian

A study of changes in American Indian population is under way in the department of anthropology at the American Museum. This study is based upon vital statistics for a number of Indian tribes in Canada and the United States over a period of fifty years, the compilation of which has been carried through by Mrs. R. D. Sanderson, honorary Life Member of the Museum. A brief report on this investigation has been published by Curator Wissler in the *Proceedings of the National Academy of Science*. This publication deals especially with the peculiar excess of adult women among the Cree Indians. It was observed that among one division of the Cree the sex ratio was 199 men to 243 women. In most populations of the world there are but small differences between the number of men and women. The publication issued is a discussion of the probable causes of this phenomena. It was discovered that among minors the number of males was but little less than the number of females, thus making it obvious that there was a higher death rate among near adult males. Further analysis of the data revealed that the high death rate for males began about the sixteenth year and continued to about the twenty-fifth year. There is no known disease that is selective in this way. On the other hand, the information concerning these Indians indicated that they were hunters and trappers and that most of the deaths among males for the period were believed due to accident and exposure. In brief, it was possible to show that this example of extreme differences between adult males and females was entirely due to mode of life. These Indians were first placed upon reservations about 1880, the statistics on their population begin a few years later, and since there was an even greater excess of women at that time than in 1934, we believe that under original primitive conditions there was a still greater number of women. In 1805 a fur trader reported that there were 76 men to 212 women. The significance of the data compiled by Mrs. Sanderson is that we see the hunting, warring life of the aboriginal Indian as especially destructive to males.

Incense Burner for the Morgan Collection

The Morgan Gem Collection has recently received as a gift from an anonymous donor a very finely carved incense burner made of leek-green aventurine, a massive variety of quartz inclosing minute flakes of mica.

This finely executed example of Chinese carving of the Kien Lung period features dragons combined with designs representing conventionalized clouds. It stands ten and one-half inches high, exclusive of its teakwood base, and was very evidently fashioned from a single block of aventurine, since the lines of color accentuation on the body of the burner extend without break into the removable cover.

Several interesting exhibits have been on view in Memorial Hall recently. From April 24th to May 18th, material used by Mr. Lincoln Ellsworth on his recent transantarctic flight from Dundee Island to a forced landing near "Little America" was displayed. The collection included a tent, sledge, supplies, and a model of the plane used. Other exhibits in May included one entitled *THE SPRING MIGRATION IS ON*, showing specimens of various migratory local birds, fish, reptiles, insects, and bats. An exhibit of various means of communication included an African drum, a picture of a smoke signal, a piece of wampum, birch bark writing, and natural history stamps. Another display that created public interest was arranged in connection with the fifth annual James Arthur Lecture on the Evolution of the Human Brain. This showed sections of the normal human brain and of a brain with tumors. A most timely exhibit was that of the life cycle of the tent caterpillar and of means of controlling this insect.

Geophysical Meeting

At the annual meeting of the American Geophysical Union held in Washington, D. C., April 30th-May 2nd, the Museum was represented by Dr. Robert Cushman Murphy, who took part in the sessions of the section of oceanography. These were presided over by Mr. Columbus O'Donnell Iselin, Commander of the research vessel *Atlantis*. Important aspects of the discussion were concerned with the submarine valleys of the coast shelf and with the new "wake current" theory which has an important bearing upon problems concerned with the Gulf Stream.

Next year it is hoped to plan a meeting of marine biologists on a day contiguous to that of the section of oceanography in order that men of science concerned with these interrelated matters may enjoy the opportunity of exchanging views.

Adult Education

The New York Adult Education Council held a series of three conferences on April 22nd, April

29th, and May 6th on "Current Trends in Adult Education." Mrs. Agnes K. Saunders represented the Museum at these conferences in which representatives from forty other organizations carrying on adult education programs participated. Mrs. Saunders spoke of the Museum's aims, methods, and flexibility, and of the success of adult education programs. Representatives from other museums of the city compared trends and problems in their respective programs. Mrs. Saunders also attended a dinner of the Council on May 4th at which Professor Lyman Bryson of Columbia was the presiding officer.

On April 25th she conducted a round table discussion in a conference on "Art Occupations in Industry" sponsored by the Institute of Women's Professional Relations. College student east of Chicago, educators, and professional men and women were invited to attend the conference. There were fourteen round tables covering broad fields of art such as Advertising, Lighting, and Movie Design. Mrs. Saunders spoke on the scope of natural history work, training required, and opportunities in the field. The conference was held at the American Women's Association and was attended by several hundred persons.

Visits of Crippled Children

During April and May the Museum was host to several hundred crippled children. On April 29th and May 14th some 500 children came from the public schools of New York City, some in wheel chairs and some on crutches, and attended a planetarium showing, were guided through the Museum halls, and saw the motion picture, "Sequoia." On April 16th thirty-two crippled children from Montefiore Hospital spent the day at the Museum, and followed much the same program. These are annual affairs and the enthusiasm and gratitude of the little visitors make their trips a pleasure to the Museum staff.

Credit

Owing to an oversight the Northern Pacific Railway did not receive credit for the use of the Indian pictures in the May issue of *NATURAL HISTORY*.

The New Books

The Study of Man—Percival Lowell—The Stars— Under the Sea—Gems and Minerals

A HUNDRED YEARS OF ANTHROPOLOGY. By T. K. Penniman. The Macmillan Co. New York, 1936. 400 pp. \$4.50.

SOCRATES, it is said, first formulated that profound but now hoary dictum: Know thyself. But except for a few tentative gestures in that direction on the part of the fellow countrymen of the sage, man has preferred, until recently, to try to know all about everything *except* himself. Medicine, the only ancient science exclusively absorbed in man, cannot be said to satisfy Socrates' requirement since its development has been largely haunted by the specter of disease and abnormality. Under such pressure it has had little time for the less pressing if more fundamental principles which have shaped man, infused him with wisdom and folly, driven him into social units and governed his behavior.

It has, therefore, remained for anthropology among other newer disciplines to attempt to fill the need for a science of man. Its career has been like Topsy's; it has often had to clothe itself in hand-me-downs; some of its garments inadequately cover its rapidly growing frame; it has disturbingly spacious prospects; in other words it is growing and adapting itself. The history of such a movement should be an absorbing document. But curiously few exist and those few are unsatisfactory. Mr. Penniman has essayed the task and has produced a book which in some respects is by far the best I have seen for the field it covers.

The author has divided the history of anthropology into a formulary period before 1835, a convergent period from 1835 to 1859, a constructive period from 1859 to 1900 and a critical period from 1900 to 1935. The philosophical and social backgrounds which produced the beginnings of anthropology in the formulary period are briefly sketched in. The early anthropological classics of the convergent period are listed and discussed. To the giants of the constructive period tribute is paid, and they are conveniently tagged for the reader. And finally the young and not so young hopefuls of the present are mentioned. Throughout this account the influences of cognate fields on the de-

velopment of anthropological thought are suggested.

I find the later period divisions rather artificial. The break between the constructive period and the critical is hardly real. I also find myself skeptical that Darwin's publication of *The Origin of the Species* provided as pervasive and as profound a motivation in anthropology as Mr. Penniman seems to believe. Without detracting from Darwin's glorious achievement and his very real influence in anthropology, there are, I think, enough examples in Mr. Penniman's own account to support the belief that much of modern anthropology has roots which go to an earlier period than Darwin. Like the Greeks, Darwin has become the *fons et origo* of historians. We tend to forget that Darwin, great as he was, was part of a movement which he synthesized and expressed more adequately than had been done before. Some of the ideas which he appropriated had in other fields already begun to sprout and produce tender shoots.

I am not erudite enough to know intimately the vast array of names which are marshaled in this book nor all the "firsts" in every field, but I seemed to detect a perhaps pardonable weakness of the author to over-stress the rôle of English anthropologists in the development of anthropology. For example, the impression is given that the English Haldane first enunciated the theory of the Asiatic origin of the B mutation in the blood groups. It is, of course, necessary that the author of a history covering so vast a field exercise some discretion in the selection of the protagonists of his account, but in view of the often lengthy treatment of relatively unknown and as yet insignificant names which are included I wonder why such important figures as Kroeber and Lowie entirely escape mention and why the profound studies of Boas on growth and environment are merely itemized perfunctorily.—H. L. SHAPIRO.

HIGHLIGHTS OF ASTRONOMY. By Walter Bartky. University of Chicago Press, 1935. \$3.00.

THE AUTHOR, who is Associate Professor of Astronomy in the University of Chicago, has written this book for the astronomical portion of the Introductory General Course in the Physical Sci-

ences, one of the four introductory courses under the new undergraduate curriculum in that institution, the object of these courses being to give the student a general educational background before he ventures to specialize in any particular field.

Doctor Bartky has given hundreds of lectures at the Adler Planetarium, and in the advertisement on the jacket we are told that he has sought to answer in this book some of the hundreds of questions people have asked him in his lectures at the Chicago Planetarium. These lectures together with his years of teaching experience have enabled him to prepare an excellent non-technical text without the introduction of mathematics. The material has been well selected, and treatment is clear and interesting. The author has unusual skill in presenting the results of mathematical investigation without the mathematical calculations.

The modernistic make-up of the book, many of its pages consisting of closely printed matter, with rather narrow margins, its chapter headings in small block letters, all tend to make the volume, according to this reviewer, somewhat formidable, which character is not deserved by the content. It is relieved, and made much more attractive, however, by many drawings by Chichi Lasley and by many astronomical photographs from the Yerkes Observatory.

Packed in 280 pages is a good working knowledge of astronomy, certainly a treatment adequate enough to enable any beginner to determine whether his natural bent would impel him to go further into the subject.

As an adjunct of the book, the author has devised an instrument, which he calls the "Stellarscope," for the study of the night sky. Through this ingenious and unique device, the stars and constellations are viewed on motion-picture film, illuminated and magnified. Each tiny sky-map, of which there are 24, is named on the film. By superimposing each individual film upon that portion of the sky, the exact identification of the heavenly bodies is made simple and easy. The "Stellarscope" is also distributed by the University of Chicago Press at the price of \$2.00.—CLYDE FISHER.

AUTOBIOGRAPHY OF PERCIVAL LOWELL. By *A. Lawrence Lowell*. The Macmillan Co., New York. \$3.00.

The reviewer is not certain whether he should compliment the author for making his late brother tell his own story, or congratulate him on cleverly combining the narrative of Percival's life with the results of the Lowell Observatory's work on the planets.

The book is really in two distinct parts. One deals with the early life and travels of this remarkable person, who was gentleman, diplomat, correspondent, author, lecturer, business man, and mystic. The other describes the growth of a passion for astronomy that gave a new unity to his life, and culminated in the building, maintaining, and endowing of a great observatory.

From his graduation from college until he was 38 years old Percival Lowell traveled through

Japan and Korea. He loved the East. He lived there as a native, and with a sympathy rare in an Occidental brought the East to the West by his delightful and inimitable pen.

As one reads the biography he sees that this was merely a period of preparation for the work Lowell was to do later. As a child he used a small telescope and read astronomical books. In college he had an excellent groundwork in science and mathematics.

Then came the sudden intention to devote himself to the sky. He organized and built his observatory. He realized that like an institution of learning an observatory is not merely a building, but involves a competent and sympathetic staff as well. Both these elements were combined and are there today in Flagstaff, Arizona as a result of the vision and ability of Percival Lowell.

The remaining half of the book quotes at length from the writings of this "amateur astronomer" and from the Annals of the Observatory. It describes the intensive work on Mars and recounts the growing conviction of Lowell that Mars is inhabited by intelligent beings. This, as some may think, was not a preconceived thesis to be proved, but a conviction arrived at only after much observation. The reviewer, like the author, cannot improve on Lowell's own words:

"To review, now, the chain of reasoning by which we have been led to regard it probable that upon the surface of Mars we see the effects of local intelligence. We find, in the first place, that the broad physical conditions of the planet are not antagonistic to some form of life; secondly, that there is an apparent dearth of water upon the planet's surface, and therefore, if beings of sufficient intelligence inhabited it, they would have to resort to irrigation to support life; thirdly, that there turns out to be a network of markings covering the disc precisely counterparting what a system of irrigation would look like; and, lastly, that there is a set of spots placed where we should expect to find the lands thus artificially fertilized, and behaving as such constructed oases should. All this, of course, may be a set of coincidences, signifying nothing; but the probability points the other way."

Next comes a period of study of the solar system and its origin; the evolution of the planets; studies in celestial mechanics on the asteroids; the rings of Saturn; and finally the prediction of a planet beyond Neptune. Even if it were a mere coincidence (which it probably was not), the finding of Pluto in 1930, fourteen years after Percival Lowell's death, completed his unfinished work. It is fitting that it should have been found at *his* observatory—and fitting that its symbol ♇ should stand not only for Pluto, but for Percival Lowell.

—WM. H. BARTON, JR.

THE STORY OF THE GEMS. By *Herbert P. Whitlock*. Lee Furman, New York. \$3.00.

Scheduled for publication in June, 1936.

To be reviewed later.

THE BOOK OF MINERALS. By Alfred C. Hawkins. John Wiley & Sons, New York. 161 pages; \$1.50.

THIS little book is not "just another Mineralogy text book"; its appeal is wider and more universal than even the university. It fits into the pocket of Boy or Girl Scouts as well as it does into that niche in their brains that is reserved for things scientific. Those of us who are privileged to come into contact with the sons and daughters of the "man in the street" know that there has been a very considerable awakening of interest in minerals during the last decade. Doctor Hawkins' book does much to stimulate that interest; its lucid diction and well chosen half-tone illustrations appeal to the novice mineral collector, no less than does its moderate price.—H. P. W.

TWENTY YEARS UNDER THE SEA. By J. E. Williamson. Hale, Cushman and Flint, Boston. 320 pages, 55 photographs. \$2.50.

FOR TWENTY YEARS J. E. Williamson has been photographing sea-bottoms, staring at octopuses, sharks, and Hollywood mermaids through the glass window of his "photosphere." This "photosphere" is a refinement worked out by Williamson on a deep-sea salvaging device invented by his father. The perfected apparatus is a four-ton metal sphere with great glass windows, hanging at the end of a flexible metal tube.

In 1913 Williamson was "photographer, artist, and often reporter to boot," on a Norfolk newspaper, the *Virginian Pilot*. In the traditional manner of young newspaper men he harbored the hope of coming "upon the one big story that will surpass all other adventures." When he conceived the notion of modifying his father's invention, he forgot all his regular assignments. His mind was "crowded with the visionary scheme of taking pictures beneath the sea."

When he brought the first successful undersea photographs ever taken back to the office of the *Pilot* (which prepared a full-page Sunday spread) Williamson was already excited over the possibility of making moving pictures under water. The rest of his book is largely given up to accounts of his exploits in making submarine moving pictures and in collecting specimens for scientific institutions.

Williamson has gotten many fearsome and beautiful effects into his undersea pictures, such as the funeral cortege in *Twenty Thousand Leagues Under the Sea*. For the struggle between the octopus and the pearl diver in this picture he constructed a most ingenious cephalopod, with a diver sitting in its head, and with its fifteen-foot tentacles writhing under the pressure of compressed air. As might be expected this octopus showed none of the timidity which makes the real octopus a rather disappointing actor; and most of the spectators were as satisfied as the newspaper critic who affirmed that "there can be no question of fake or deception."

Mr. Williamson, among other adventures, has killed his shark, diving beneath it with a knife, in the good old Bahama fashion, but the most alarming experience he had was when he felt an anomalous shape crawling within his helmet. When he finally was drawn up to the surface he found that a scorpion had secreted itself in the helmet.

The photographs include magnificent coral groves, gaily striped tropical fish, fantastic scenes from under-water motion pictures and an abundance of sharks.

While Mr. Williamson makes no pretense of being a scientific observer, and is certainly over-generous in the use of expressions like "man-eater" and "monster," his book is continually entertaining, and sometimes exciting.—G. L.

A WORLD OF CHANCE. By Edward Gleason Spaulding. The Macmillan Co., New York. \$3.00.

THIS book is an argument for a thorough-going Indeterministic position as regards the Structure of Reality, to include in the meaning of this term not only Nature, but also that realm of fact which is not part of Nature, but of which, conversely, Nature itself is an instance." To his own questions Whence, Whither, and Why, Professor Spaulding finds the answers From no Source, To no End, and For no Reason. He considers that this is a Pluralistic universe and that the World, in the broadest sense, is a world not of necessity, but of chance.

Recent Museum Publications

NOVITATES

- No. 837. A Classification and Phylogeny of the Elasmobranch Fishes. By E. Grace White.
- No. 838. The Heart Valves of the Elasmobranch Fishes. By E. Grace White.
- No. 839. *Pagothenia*, a New Antarctic Fish. By J. T. Nichols and F. R. LaMonte.
- No. 840. African Bees of the Genus *Allodapula*. By T. D. A. Cockerell.
- No. 841. Records of North American Gnaphosidae with Descriptions of New Species. By Ralph V. Chamberlin.
- No. 842. The Australian Ant Genus *Froggattella*. By William Morton Wheeler.
- No. 843. African and American Oligochaeta in the American Museum of Natural History. By W. Michaelsen.
- No. 844. Western Bees of the Genus *Cerathina*, Subgenus *Zaodontomerus*. By Charles D. Michener.
- No. 845. A New Genus and Species of Fulgorid from Haiti (Homoptera: Fulgoridae). By Herbert L. Dozier.
- No. 846. Results of the Archbold Expeditions. No. 9. A New Race of *Hyosciurus*. By G. H. H. Tate and Richard Archbold.
- No. 847. African Hylaeine Bees. By T. D. A. Cockerell.

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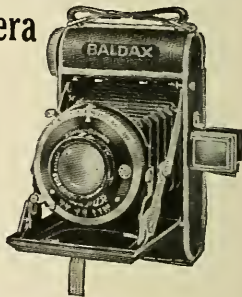
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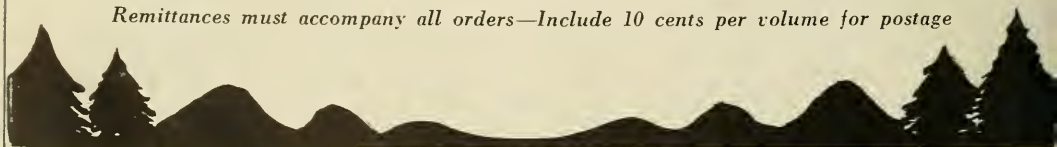
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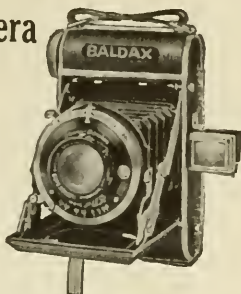
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By A. P. MORE

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

VOLUME XXXVIII

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SEPTEMBER 1936

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HE GETS THE IRON

Showing the latest tactics used against the most hated and feared creature of the sea: Colonel Wise, toward the finish of a hot fight, ready to land a shark by the unusual technique which he has perfected

Tigers of the Sea

The truth about sharks, told by a man who has devoted years to outwitting them. The first of a series of three articles

By COLONEL HUGH D. WISE

U. S. Army, Retired

A COMPENSATION for hardships and uncertainties of active Army Life is the opportunity it affords for sport with rod and gun in many parts of the world. I have taken full advantage of this but omit here discussion of all but shark-fishing which I have pursued at home, in Cuba, in the Philippines, in Hawaii and in the Bahamas.

My first exciting experience with the shark was as a youngster in my early teens. I used to go out on Matompkin Inlet, on the Atlantic side of the Eastern Shore of Virginia, with a crew of market fishermen. Those were wonderful days, when glorious fishing always ended in a sailing race between the fishing boats up Folly Creek to Drummondtown, each boat trying to be first to market.

Taken for a ride

One day, boy-like, I had gotten into the dory swinging astern of the "bateau" "Lottie Garrison" and was fishing there when a big Hammerhead whizzed past, turned and began slowly circling the boats. From my pocket I took a large hook which I had treasured there for weeks, tied it onto the end of the painter of the dory which was simply looped over a cleat on the "bateau." I baited it with a weak-fish and cast out. As it floated on the surface fifty feet away, the Hammerhead on his next turn took it with a gulp—"Snap!"—The painter tightened and the dory's bow went almost underwater, bobbing up and down, while its stern skidded crazily from side to side. I managed to whip the loop free from the "bateau," scrambled over the thwarts to

the stern of the dory, and got an oar into the sculling groove. So, holding the dory head-on, I was taken for a ride at speed hitherto never experienced by me in a small boat, for motors had not then been invented.

"Where the—do you think you're going?" shouted Captain Billy Milner, as I scudded past. This was really a useless question, for no one could have had less idea than I had of where I was going. I was on my way, however, and I was going fast.

In chase

I seem still to hear the unparliamentary remarks shouted after me by that salty crew whose fishing I was spoiling at the very best of the tide, for Captain Billy, who felt some responsibility for me, had ordered fishing lines in and sails up. Overboard went his cable and he was after us, but we had a half-mile start before the "bateau," leaning to the breeze, was under headway.

In a mile or so they had nearly overhauled us but my tug then suddenly changed its mind and we shot off to windward, giving our pursuers a two-mile beat of it before Captain Billy grabbed the dory's stern with a boat-hook and his crew dropped sails. Then shark, dory and "bateau" moved in procession at a somewhat slower speed until strong arms hauled in the offending shark and murdered him. By this time the crew, in the excitement of the chase, was no longer murderous in its intentions toward me and I was thrilling with delight at the sport I had given them, quite unpenitent of having spoiled their morning's catch. On the contrary, I think I was proud of having provided such an incident. From that time on I have been a confirmed shark-

fisher, but was too closely watched by Billy ever again to play that game when out with him.

This shark had every temptation to attack the little dory, but he did not do it, nor since then, under similar circumstances, have I seen one do it. A lameness which I brought home with me from the World War put an end to my hunting and to my fishing on foot, but there had to be outlet for the sporting instinct developed in me by a life of service in the army with hunting and fishing around the world. Bass-fishing and blue-fishing were still practicable and I enjoyed them but, in Hawaii and the East, I had had a taste, a good big taste, of angling for heavy sea fish and this had somewhat marred my zest for pursuit of smaller varieties. Pegging away to find what I could do, I soon learned that though my stream-wading days were done, I could still be "hell in the swivel chair!"

For many years I had had fun fishing in various ways for sharks, but now I took to angling for them with rod and reel at times when I could not reach other big fish and, in so doing, I developed for myself the somewhat unique or at least unusual game which I shall describe later.

Glamorous combat

There is a glamour to this fishing which comes with no other angling. I have tried to analyze its fascination, which seems really to be the zest of combat with the "Tiger of the Sea," for whom there is no feeling of pity to mar the exultation of victory. Even for the swordfish, which may be as big and as strong as most sharks, one feels a regret when he is killed; but, for the shark, there is no compassion—he is a pariah. When he is brought up, his glaring amber eyes evoke no feeling of kindness and his snapping jaws, with dreadful dagger teeth, convey only the impression that he is an armed enemy who would give no quarter and who is entitled to none. From the moment when he takes the hook, his capture is a fight—a fight which excites the lust to kill a predatory creature whose life is a menace to all other denizens of the sea, and whose death will make the angler their protector.

A question sure to be asked when sharks are mentioned is: "Do sharks attack and kill men?" Whatever be the reply, there is likely to be a dispute, because the question, in such

simple form, cannot be definitely and authoritatively answered.

Sharks do not go forth to stalk men as cats do mice nor to catch them as wolves do deer. Fish are the regular victims of even the most predatory sharks, and man, though probably an acceptable morsel, would be a most unexpected addition to their menus. Nevertheless, sharks do occasionally get him.

We can only guess at how much truth there may be in the yarns we hear of shark attacks, but there must be a more solid foundation than superstition and imagination for the general and real fear of sharks shared by practically all watermen, though few of them can cite cases of shark attacks within their own personal knowledge.

Killings

There are countless instances of the eating of dead men by sharks, and there are many reports of their attacks upon live men. Both our War Department and our Navy Department officially report several such killings. Governor Pinchot tells of one such in Tahiti, and Captain William Young has collected in his book some authentic reports. Nevertheless, I have repeatedly seen soldiers from transports, in shark-infested waters, swimming unharmed about the ship and thousands of tourists watch natives diving for pennies at tropical ports, where harbors are teeming with sharks, without ever seeing a diver harmed by one.

Probably the most dangerous species in our North Atlantic are the Great White Shark, the Great Blue Shark, and the Tiger Shark, none of which is really common in our waters, but it seems to be a generally accepted fact that sharks are more dangerous in the tropics where, incidentally, these species are common.

To get facts in this much contended question of shark attacks on man, Mr. Herman Oelrichs, some years ago, offered, through New York papers, a reward of five hundred dollars for authentic information of such an attack in our waters, but the reward was never claimed. Similar rewards were later offered, and a number of papers took up the discussion which brought to light no credible instance in our zone though there were a number in tropic waters.¹

The late Dr. F. A. Lucas, of the American Museum of Natural History, quite thoroughly

¹ Brooklyn Museum Bulletin, Vol. 3, No. 1.

investigated this subject and he believed that the danger of being attacked by a shark in the vicinity of New York is "infinitely less than that of being struck by lightning." Nevertheless, periodic shark scares persist, and in one of these, in 1932, newspapers published alarming casualties on our bathing beaches. Some resorts even safeguarded swimmers by wire fences in the surf and the barbs of these were probably more dangerous to the bathers than were the teeth of sharks.

At the height of this excitement Mr. C. M. Breder, Jr., of the New York Aquarium, made a trip to study conditions in local waters, but found sharks no more numerous nor ferocious than usual and he concluded that most of the panic was probably due to publicity and exaggeration and that at that time there was not an authentic case of attack by sharks in our region. It is quite necessary to realize that there is a difference between shark bite and shark attack and that lack of caution may, and often does, result in severe laceration from the teeth or in a terrific wallop from the tail of a frightened or wounded shark.

Danger zones

In some parts of the world sharks are much more dangerous than they are with us and Dr. C. H. Townsend, Director of the New York Aquarium, has furnished an article* which should remove all skepticism as to whether sharks will attack men. He cites numerous instances in which men were attacked and devoured and tells of cases where not only were swimming men seized but also where sharks grabbed the oars or outriggers of boats.

In Polynesia, the almost amphibious natives regard the shark with a dread akin to that of the African for the lion, though the shark takes less toll in human life because he cannot stalk his prey, as does the lion, on land.

In Australia, the shark is a greater danger than he is with us. Especially is he a menace in Sydney Harbor where his predatory habits have doubtless been encouraged by the custom of disposing of slaughter-house refuse in the bay and so chumming up the sharks.

In the Solomon Islands, sharks are singularly bold and ferocious, which may be accounted for by the custom of disposing of the dead by throwing their bodies into the sea—

thus literally training the sharks to eat men.

Interesting conclusions of Doctor Townsend are that sharks of tropical waters are more ferocious than those of temperate zones, that sharks are more dangerous at night than in day, and that the most dangerous time is dusk. Also he believes that large sharks are not necessarily more dangerous than those not so large and that all sharks are particularly dangerous when swarming on feeding grounds.

This all seems to confirm my own belief that, while sharks do not set out on man-hunts, they will, under favorable circumstances, attack man, especially if impelled by hunger, excitement or the blood-scent, and that they are particularly dangerous when in feeding swarms.

It is going a little strong to say, as recently did one scientist, that a shark will not attack man unless he gets the blood-scent for, though that unquestionably excites him, there are many authentic cases where he has attacked without it. Nevertheless, it is my opinion that a shark, except when surprised, attacked, or greatly excited, rarely attacks a man whom he does not believe to be dead or helpless; and I believe that, except in self-defense, a shark prefers to avoid anything which might fight back. It is prudent, however, not to risk being the victim in an exceptional case. Since the angler, if he accepts my advice, will try to stay in his fair-sized motor boat, the man-eating tendencies of sharks are not of immediate importance, nor is it here necessary to convict or acquit the shark of anthropophagy. Suffice it to say that I do not recommend him as playmate at a bathing beach.

A bad moment

On one occasion in the Philippines I was shark-fishing from a canoe. A big Tiburone was towing us around, when he suddenly turned and rushed head-on against the boat. His impact threw the two paddlers and me into the bottom of the boat and, as I wallowed there, I had a distinct sense of relief when I felt the rope tauten as the shark, having swung away, took up the slack. This might make a fine story of a shark attack, but I am afraid that I will have to admit that the shark had no intention of attacking that boat but simply collided with it in his frantic efforts to escape.

This large, ubiquitous and abundant fish

*Bulletin 34, N. Y. Zool. Society, Vol. XXXIV, No. 6, 1931.

which, except to a few sportsmen, has for centuries been but a nuisance, has recently become of economic value, and commercial companies are now engaging in shark-fishing as a profitable enterprise. Their catches taken in large specially constructed nets, are measured by tons and practically all of this weight of fish is utilized. Formerly, shark hide or "shagreen" was used mainly as an abrasive, like sandpaper, and it was of great service for cleaning decks. Its non-slippery quality made it useful for sword hilts and tool handles and its durability for bags and pocketbooks; only recently a process of tanning was discovered which effectively and economically removes the denticles of the skin, and thus converts the hide into a beautiful leather of superior toughness and durability, called "galuchat."

The liver of a shark may be a fourth or a fifth of his weight and oil from the liver, about four gallons from a six-footer, is used in tempering steel, in paint, and in many other commercial ways. Medicinally, it has been found to possess vitamins which make it a rival of cod liver oil.

Shark as food

Dried fins, used for the famous shark-fin soup, bring good prices wherever there is a Chinese population, and quantities of them are exported to China.

Certain varieties of shark whose flesh is especially fine of texture and delicate of flavor, are marketed as "steak fish" and "grey fish," others are salted and packed, while plugs punched from shark steaks and ray fins and doped with clam juice, become "deep sea scallops." The less desirable flesh is dried and ground into poultry meal and the remainder is reduced to fertilizer.

The prejudice against eating shark meat seems largely due to the idea that sharks are scavengers as, in fact, some of them are, though no more than most other fishes and crustaceans, especially crabs and lobsters; and I know of at least one famous trout pool which is close to a sewer outlet. Many people enjoy shark meat without suspecting what they are eating.

Once, while watching my boatman skin and trim a two hundred pounder, I asked, "What are you going to do with that shark?"

Grinning, he replied, "This was shark—now it is just fish—tomorrow, in the market, it will be swordfish."

A serious charge against the shark and one which can be sustained, is the great damage he does to fish-traps and nets, and the tremendous toll he takes of fish which men want for themselves. This indictment of the shark may serve to salve the conscience of the sportsman who goes forth to assassinate him. Certainly it will make easier the getting of bait because seine-men are ever ready to contribute trash fish for a fight against their arch-enemy.

One of the sea's leviathans

The shark belongs to one of the largest and commonest orders of fishes of the present times and is also one of the oldest living vertebrates. He has come down from past geological ages little changed except in size, for, big though he now is, he was larger then, fossil remains showing that he may have been over a hundred feet in length.

One almost needs logarithms to calculate the weight of such a fish but, since his length, exclusive of caudal fin, would be about 974 inches and his girth about 450 inches, his weight, by a rather reliable formula, would be:

$$\frac{450^2 \times 974}{800} = 246,543 \text{ lbs. — or about 123 tons}$$

Such conjectures aside, there is in the American Museum of Natural History the reconstructed jaw of one of the leviathans which swam the seas when glaciers covered the northern part of our continent. The fossil teeth of the *Carcharodon*, averaging $4\frac{1}{4}$ inches in length, found in the Tertiary deposits of North Carolina, are set in a jaw modelled after the jaw of the White Shark, his nearest living relative. This jaw would easily take in a four-poster bed and, from the estimated length of the fish, we can calculate his weight as over thirty-eight tons.

It is remarkable how little is known of the habits and characteristics of this oldest and largest of our common fishes. Even Garman, the recognized authority on shark taxonomy, barely touches upon this subject. Sharks have swum the waters of our globe for more than three hundred million years but much about them still remains a mystery. Let a man embark upon an investigation of them and he will soon find himself engulfed in such a welter of scientific fact, unsubstantiated legend, imagina-

tive folk-lore and plain garden variety of fish story, that he is hopelessly swamped. He will probably conclude that he is dealing with "all kinds of a fish" as, in fact, he is, for the order, Plagiostomia, includes the huge Manta and the little Skate, the great Whale Shark and the small Dogfish, the vicious White Shark and the cowardly Nurse. There are among the sharks deep-sea flesh-eaters and shoal water mollusk-feeders. They are found beneath Arctic ice and on tropic coral reefs. They cruise mid-ocean and haunt the waters of coastal marshes, but, wherever sharks may be, they are undisputed masters, and upon their slithering approach all other denizens fin away. Whether harmless to man or a menace to him they are hideous and they are hated.

Face inspires dread

There may be justification for this hatred of the savage predatory shark and for the descriptive "hideous," usually applied to him, but in fact it is only his face, with leering sinister eyes and dreadful spiked teeth, which makes him hideous, otherwise his graceful form and delicate shade would make him beautiful. No creature of the sea is so gracefully lithe as the shark, silently gliding through the water, but none is so terribly fearsome as he when he dashes at his prey.

In his physical structure, the shark is highly specialized to meet conditions under which he exists, while, as a vital organism, he presents some features which are almost unique. Conspicuous among these are his spiral valvular digestive tract and his dual organ of reproduction. For a fish, he has a well developed brain, his sense of smell is acute and his hearing is supplemented by nerves, which are extremely sensitive to vibration.

There is no air-bladder, as there is in most fishes, so the shark, deprived of this means of changing his specific gravity, must regulate his depth by muscular effort, in other words, by swimming; he is therefore rarely seen quiescent.

In nearly all species of true sharks, a long, lithe, muscular, fusiform body tapers from its largest part, about a third of its length back of the nose, forward into a pointed conical head and aft into a long, round, graceful tail or peduncle, which terminates in a large swallow-tailed caudal fin, or fluke.

Different from the swimming of most fishes

and characteristic of that of the shark are the sinuous undulations of his body by which he supplements caudal-fin propulsion and this gives to him a peculiar slithering, ghost-like glide. His litheness is in large part due to the absence from his body of stiff bones, for his frame is mainly of heavy cartilage; his only fossil remains are the enameled-covered teeth.

Over his cartilaginous framework is stretched his truly marvelous muscular system covered by a denticled hide, so tough and so protected by small, close-set, horny scales as to defy all but sharp, well tempered instruments and almost to justify the saying that "only a shark can bite a shark."

The first dorsal fin, usually large and erect, is much larger than the second dorsal, the anal and the ventrals. Pectorals are usually long and sickle-shape. The size, shape, and position of all of these fins vary with different species and are to be noted as important clues to identification. Only the caudal fin, which is also important for identification, is important in propulsion; other fins being used mainly for balancing and guiding.

Near the ventral fins, in male sharks, are found the "claspers," which might be mistaken for fins but which, in fact, are sexual organs.

Gill-openings are usually five (in some species, seven) parallel vertical slits which are not covered as in other fishes, and the spacing of these slits is another clue for species identification.

Teeth

The mouth, situated beneath the head, the nose projecting well beyond it, gives to the shark the familiar, disagreeable "overshot" expression. The mouth is of enormous size and is sometimes supplied with as many as seven visible, parallel, curved rows of teeth. Only the front two or three of these rows are functional, those in the rear being in successive stages of development and inclination backward while still more rows have not made their appearance. The teeth are not set in the bone of the jaw but grow from the hardened skin of the mouth. As this skin grows forward the teeth develop and rise to vertical position and the rows are successively shed over the front edge of the mouth. The fish is thus constantly provided with new dentition and this explains why so many shark teeth are found on the shore and why fossil teeth are so abundant.

The difference between teeth of species is a valuable means of identification as well as evidence of the habits of sharks of each species.

Most sharks either bite and swallow their food down large gullets, as do the White, the Blue and the Mackerel, or they crush it as do mollusk-eaters, like the Nurse and the Dogfish—none of them chew and masticate. Some species, notably the great Whale Shark*, feed on small fishes, jelly fishes, small crustaceans and algae which pass down their small throats after being strained from huge volumes of water by their gill-brushes. For obvious reasons, their teeth are small, and one family, the Basker, substitutes for teeth a brush-like apparatus which serves as a sieve.

Even in the group which we may call "biting swallows" there are different tooth shapes for the different species and this helps distinguish them. The Mackerel Shark has long pointed teeth, the White has broadly triangular ones; the Hammerhead combines these puncturing and cutting qualities in his narrow triangular teeth and the Tiger Shark's teeth are large, broad and sickle-shaped. The broad and rather flat teeth of mollusk-feeders are set like paving tiles and sometimes are practically jointed together.

Fast swimming species feed usually on live fish which they pursue and capture, but slower ones may have to content themselves with mollusks, crustaceans or even with offal. In general, however, the shark is not a carrion feeder.

One objective—food

With their equipment for offense and defense, sharks have naught to fear in the sea where no other fish will attack them, where their only danger is from other sharks, where their whole existence is but a continuous search for food to satisfy insatiable appetite. The shark is always hungry—he suffers from incurable belly-ache. Be it live fish, dead fish, flesh or fowl, all is grist for the shark's mill and he is always on a predatory prowl after it. Never does he seem to rest. His big fins appear above the surface, or beneath it he slithers in from nowhere, but he is always headed for the same objective—food.

*Dr. E. W. Gudger has written on the Whale Shark in the following numbers of *NATURAL HISTORY*: January-February, 1923, p. 62; March-April, 1930, p. 182; September, 1935, p. 128; and February, 1936, p. 159; in *Bulletin of the American Museum of Natural History*, 1935; and in *Novitates* No. 318, 1928.

What may be the span of the natural life of a shark is yet undetermined for he has no scales, whose rings might tell his age, and his teeth are but temporary equipment. It is doubtful, however, whether many sharks live out their natural lives for, if ever they lose, even temporarily, the capacity to defend themselves, other sharks are quick to kill and eat them.

Sharks are the most cannibalistic of cannibals and in large ones are often found smaller ones which have been devoured. Dr. E. W. Gudger, of the American Museum of Natural History, has published a most thorough and instructive paper on shark cannibalism, in which he shows that practically all sharks prey upon other sharks as well as upon their cousins, the skates and rays.*

Powers of digestion

I once saw taken from the stomach of an eight-foot shark, a three-footer which had been swallowed whole. To appreciate that gastronomic accomplishment, one must remember not only the size of the morsel but also the sharp teeth, the hard stiff fins, capable of cutting a heavy line, and the tough denticled hide which defies ordinary tanning processes. One wonders at gastric juices which can digest such things as are taken from the stomachs of sharks; for example, a horse's hoof with the iron shoe on it—the bones had been completely dissolved, the horn casing was softened to the consistency of leather and the iron was being rapidly corroded. Could doctors use shark juice instead of pig juice to get pepsin? In this digestive fluid there is a very high content of hydrochloric acid, and I have seen it remove the varnish when spilled on a deck.

Nevertheless, we read in Darwin's *Voyage of the Beagle*—"I have heard from Doctor Allan, of Forres, that he has frequently found a *Diodon*†, floating alive and distended in the stomach of a shark; and that on several occasions he has known it to eat its way, not only through the coats of the stomach, but through the sides of the monster, which has thus been killed. Who would ever have imagined that a little soft fish could have destroyed the great savage shark?"—Who would imagine it? We must say, like Charles Dana, "Important if true," but we may conjecture at least that

*Gudger, E. W.—"Cannibalism among Sharks and Rays," *Scientific Monthly*, May, 1932.

†A species of puffer fish.

the Diodon had an uncomfortable swim.

It is not uncommon for sharks to attack another shark when he is held on a line and to bite great chunks out of him and it is still more common to find sharks which have been partially devoured while they were enmeshed in nets. Apparently, they live in armed neutrality, but when one of them becomes disabled or helpless his comrades give him short shrift.

Speaking of the slashing of one shark by another brings to mind the old superstition that a shark must turn on his back or side to bite. To one who has watched sharks take the bait and who has seen them bite one another, this is, of course, utter nonsense. A shark's eyes are not well placed for forward-downward vision, so he may have to roll for better view; and, frequently, the roll is but the preliminary of his dash at an object.

Another foolish idea is that female sharks swallow their young to protect them, disgorging them when captured. The fact is that, on capture, viviparous females often give birth to their young and, incidentally, it may surprise you to see how self-reliantly the pups swim away when tossed overboard.

An arrant coward

Contrary to popular idea, the shark is wary, almost timid, for monster though he is, he is averse to taking chances. He is however, possessed of a curiosity which sometimes urges him on and makes him appear bold when, in fact, he is terrified; but at heart, if his heart be aught but a blood-pump, he is an arrant coward.

Nothing could better illustrate the curiosity and the timidity of sharks than an incident related in Captain Young's book. A diver working with him in Hawaii was constantly surrounded by curious sharks which, however, did not molest him; but, when they nosed up uncomfortably close, the diver released some air bubbles from his wrist-band and this sent them gliding away.

Even a large shark, with a large skull, has but a handful of brain-matter for the brain-cavity is only partly filled. Nevertheless, this handful seems to provide him with a disproportionate amount of suspicion and with perception enough to beware of a bait tied onto a string. I have seen sharks rush furiously up to a bait then stop, draw back and examine it,

but they would instantly seize and gobble an identical free bait floated out to them.

Usually a shark does not take the bait with a rush but will first seize it in his teeth before swallowing it. When, however, he has decided, he takes it with a gulp.

Blood lust

However hesitant sharks may ordinarily be, all hesitation leaves them with the smell of fresh blood, which puts them into a frenzy. Testing this one day when several sharks were cautiously nosing at my bait, I poured over the boatside some blood from a recently captured shark. Instantly one of the investigators seized the bait and the others went frantic. Taking advantage of this characteristic, I have always since then bled newly caught sharks over the gunwale, usually with good results.

Under skin-flaps in the anterior portion of a shark's head are two large nostrils and as his olfactory organs are excellent, his sense of smell is acute. He gets the blood-scent at amazing distances and rushes toward it. Literally, it seems to make him see red.

For this reason, blood is good chum and there is no better chum than the warm rich blood of the porpoise, though any blood, from fish, fowl or animal, will attract sharks.

When not excited by the blood-scent, sharks are surprisingly wary and alert. As they circle the boat, their unblinking yellow eyes are ever on watch, and their sensitive nerves are always atune. A wave of the hand or a sudden noise sends them gliding away, to return, probably, when impelled by irresistible curiosity or insatiable appetite.

By "noise," I mean vibration or jar in the water, for I have observed that they do not seem to be afraid of other noises, such as loud talking, for example. To try this out, I have even shouted at sharks swimming close to the boat without alarming them in the least, but a bang on the boat-bottom sent them dashing away. Nevertheless, for some unknown reason, talking seems to make them timid about taking the bait.

Most sharks are very moderately gregarious but, where one is found, there will probably be others, temporarily together, because their individual searches have led them to that place on the trail of food. When their maws are filled, or when the possibilities of the locality are exhausted, they will leave to resume their

ceaseless prowls in search of more food.

In most sharks there is little instinct to school, like the bluefish for example, though some of the smaller species do at times swarm, and Nurse Sharks and certain Sand Sharks assemble in great numbers in shallow water at breeding season.

No admirable traits

Being masters of the sea, sharks need not join for defense; community of interest does not exist in their selfish, individualistic natures, and, in their lives, every fish is for himself. Most animals and many fishes unite against common foes but sharks do not, unless there be prospect of a feast after the battle.

Even a ewe will fight for her offspring, but I have never heard of such action by a female shark. When her pups are born she is done with them.

In the study of animals, or even of fishes, a man usually finds something likable about them, but in the monstrous, cruel, cowardly shark he can find not one admirable trait—he is simply a tiger.

The white fishermen of the "Eastern Shore" detest sharks because of the loss they suffer from them, but, to this detestation, the colored population add a superstitious dread. Of the colored men about my father's place, Silas, alone, was ever ready to go fishing with me and I always wanted him because he saved me the labor of stepping masts and hoisting anchor. One day we took with us Tom, a young man who affected to share the contempt which Silas had for sharks, and who kept repeating Silas' slogan: "Dey kaint hurt yer in de boat."

We were soon hung onto a big shark which

they were hauling in while I, at the tiller, maneuvered the skiff to give them slack. In the process of these operations, the shark swished the rope across the stern, and, catching Tom's leg, threw him overboard. He could swim, and all he had to do was to get hold of the rope and haul aboard by it but the idea of a shark at the other end of that rope, fifty yards away, was so horrible that Tom was deprived of reason and, his eyes rolling white while the tide took him back, he simply howled: "Bring dat boat! Oh Lord, get dat shark outen here! Oh Lord, take dat shark away!"

When we finally hauled Tom (and the shark) aboard, Tom was given the honor of being allowed to bash in the shark's head with a hatchet. At the first wallop, the shark opened and snapped his jaws.

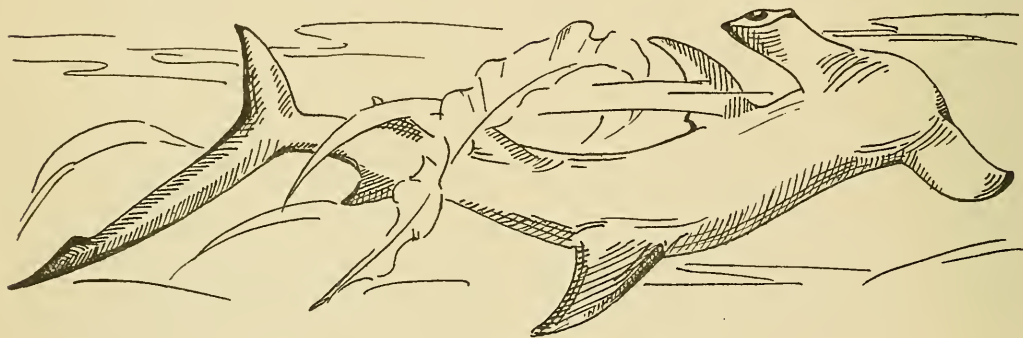
"Shut yer mouf, Shark!" yelled Tom, with another wallop, "I'se seed all I wants ter see of dem teeth—an' I'se done felt 'em too—tearin' through my gizzard when I was back thar in de water wid yer!"

The shark's tenacity of life is amazing. He seems to be immune to nervous shock, cruel wounds affect him only slightly, and he remains dangerous a long time out of water. I have seen a shark, whose liver had been removed for chum, swim strongly away and I once saw a boatman knocked over the gunwale by a shark which had been in the boat nearly an hour.

In the next month's NATURAL HISTORY Colonel Wise will narrate a number of exciting encounters he has had with sharks off the eastern coast of the United States while perfecting the rod-and-reel methods of which he is chiefly the originator.

HAMMERHEAD SHARK

Drawn by Else Bostelmann



Tigers of the Sea



(Photograph by James Thompson from Globe)

The shark has recently become of commercial value, and companies are profitably fishing for him. Their catches are measured by tons, and practically all of the fish is utilized. Large nets are generally used, but in the above photograph we see a Mako Shark about to be harpooned after a two-hour battle with hook and line

Shark fishermen hauling in a Nurse Shark to be converted into shoe leather. Formerly, shark hide or "shagreen" was used mainly as an abrasive, like sandpaper, and for covering tool handles. Recently a process for removing the rough denticles of the skin has made it possible to convert shark skin into a beautiful and serviceable leather, called galuchat

(Globe Photo)

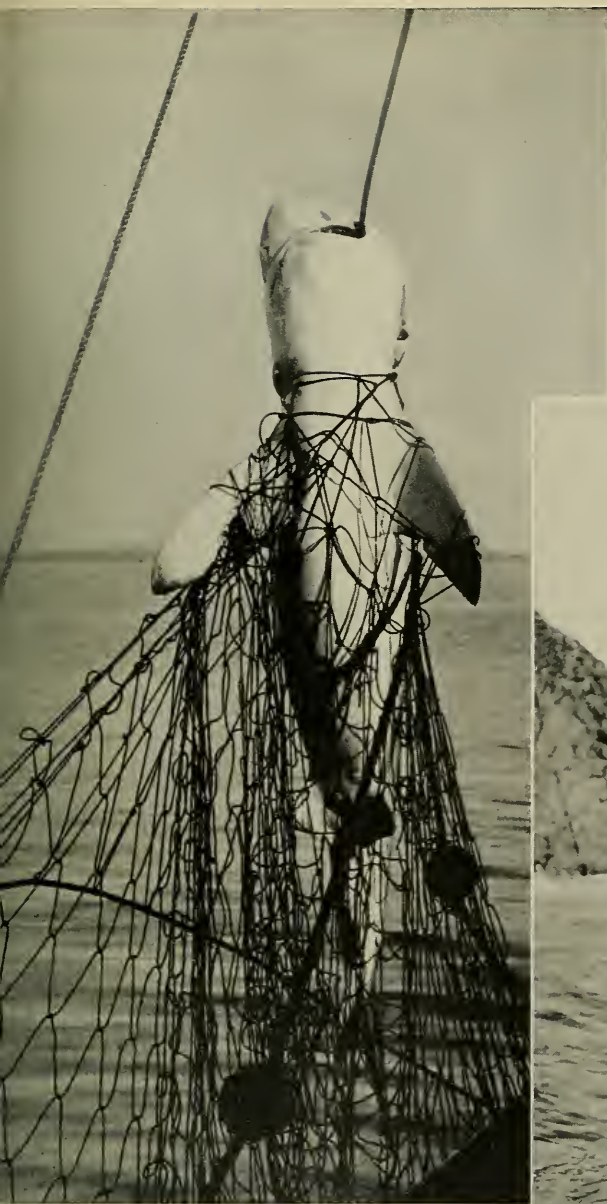


Snapping jaws and thrashing tail make the task of landing a shark dangerous. A harpoon or swordfish dart is generally driven into the fish when it is brought alongside, but it is well-nigh impossible to judge when he is dead. The

author of the accompanying article has seen a shark whose liver had been removed swim strongly away, and on one occasion a shark which had been in the boat nearly an hour knocked a boatman over the gunwale

(Photo by Rudolph H. Hoffman, from Black Star)



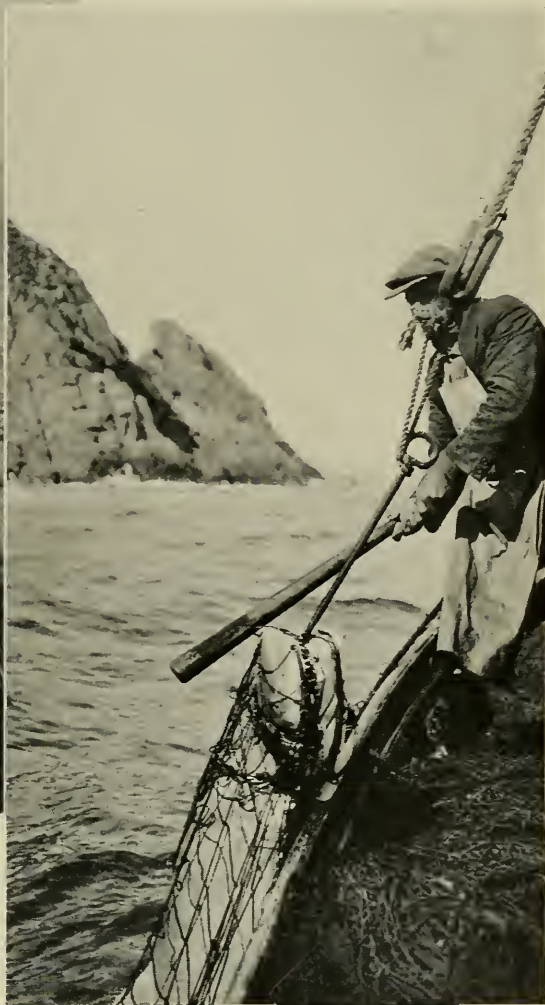


(Mondiale from Black Star)

(Above) The shark runs his head through the net and in thrashing about entangles his fins. At the surface a large iron hook is fastened through his jaws and he is then hauled out with a derrick

(Below) At the rail a death-blow is easily delivered on the snout, where the shark's brain lies close to the surface.

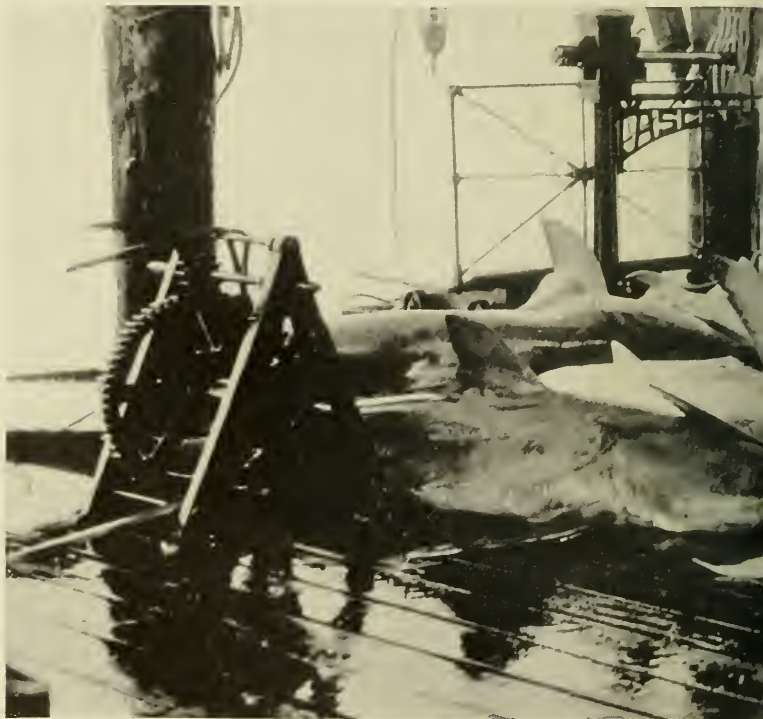
(Mondiale from Black Star)





Courtesy of E. M. Schantz

*(Above) Tons of Tiger Sharks: a haul of the National Fisheries Corporation ready for processing
The liver of a six-foot shark will yield four gallons of oil, useful in tempering steel, in making paint, and in many other*





Courtesy of E. M. Scheutz

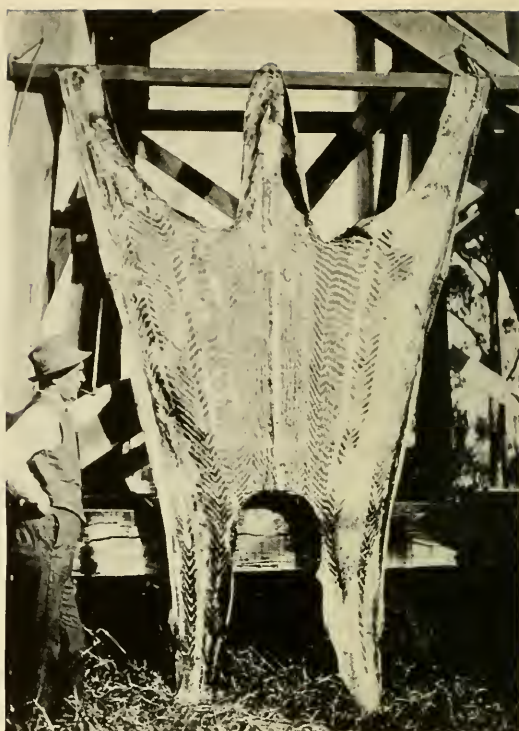
commercial ways. Medicinally, shark liver oil possesses vitamins which make it a rival of cod liver oil
(Below) A 24-hour catch of Tiger and other sharks off the Australian coast
(Mondiale from Black Star)





(Courtesy of E. M. Scheutz)

A big Tiger. This fellow will provide leather for shoes, bags, belts, and pocketbooks; ten gallons of oil and lots of shark fin soup



(Mondiale from Black Star)

Tanned hide of a shark: 42 square feet of leather. Before the denticles are removed the "shagreen" is useful for sanding and cleaning decks



Leather and shoe made from the tanned skin of the smaller carpet shark,

so called because of the pattern

(Mondiale from Black Star)

Ice from the Thunderclouds

Hail—A \$200,000,000 yearly menace; its cause and attempted prevention; record hailstones and hailstorms that changed the course of history

By CHARLES FITZHUGH TALMAN

*Late Meteorological Consultant,
U. S. Weather Bureau*

WHEN a record of weather occurrences tells us that hail has fallen, the statement may seem definite to the layman but often raises a question in the mind of the meteorologist. For centuries people talked and wrote about hail before it occurred to men of science to inquire whether one and the same thing was always described under this name.

What is hail?

There are at least three different kinds of icy lumps and pellets that fall from the sky, and they have all been called hail. What science now regards as true hail occurs only in connection with thunderstorms, either incipient or fully developed, and therefore chiefly in warm weather. It often falls in tornadoes, but probably only when these occur in a thunderstorm area. Hail, as thus distinguished, consists of balls or irregular lumps, each of which, on examination, is usually found to have an opaque snow-like center, surrounded by ice, which is often in alternately clear and opaque layers.

The second class of icy particles takes the form of miniature snowballs, about the size of large shot or small peas. It falls in cold weather, often in conjunction with ordinary snow. Because it readily crumbles, English-speaking meteorologists have commonly called it "soft hail"; but this term is now giving way to the Germain name "graupe."

Lastly, little pellets or angular particles of clear ice sometimes fall in cold weather. These frozen drops, though fairly common, have,

until recently, enjoyed the distinction of being anonymous, so far as the scientific world was concerned. In the year 1916, the United States Weather Bureau took the bull by the horns and decreed that such ice particles should be called "sleet"—a word, alas! of many meanings.

A clue to the origin of hail is furnished by the appearance of the typical hailstone. The successive layers of clear and snowy ice are evidently acquired in the course of several journeys up and down, between relatively cold and relatively warm regions of the atmosphere, before the stone finally falls to earth. At high levels the incipient hailstone is coated with snow, and at lower levels with rain, which turns to ice as the stone is again carried aloft. Probably the only place where such a process could occur is in the turbulent uprush of air at the front of a thunderstorm, consisting, as it does, of blasts violent enough to drive a heavy hailstone upward, alternating with lulls that would permit it to fall.

Red hail

Most hailstones are approximately spherical or somewhat conical, but other and very striking shapes are sometimes found. Occasionally the surface is encrusted with curious crystalline growths. Red hail is not unknown. As in many cases of red rain and snow, the color is due to fine dust in the atmosphere, generally blown up from deserts.

Many descriptions of hailstorms tell of a roaring or rattling sound heard during the approach of the storm and apparently coming from the clouds. Some writers compare it to that of heavy vehicles passing over a road or the clatter of many horses' hoofs. Typical of

the accounts of it found in the older works on meteorology is the following from a once standard treatise by Professor Loomis:

"Some seconds before the fall of hail, and occasionally several minutes, a peculiar crackling noise is heard in the air. It has been compared to the noise of walnuts violently shaken up in a bag. This noise has been ascribed to the great velocity with which the hailstones are driven through the air, while some have ascribed it to feeble electrical discharges from one hailstone to another."

The noise has not been the subject of much critical investigation, but the best guess as to its origin is probably that offered as long ago as the year 1885 by the French meteorologist, J. N. Plumondon. According to this authority it does not come from the air or the clouds, but is merely the combined sound of many hailstones falling on leaves, roofs and the like at some distance from the observer. When the storm is actually at hand, the observer hears the patter of individual stones in place of the mingled noises of a great number.

Big tales of big hailstorms

India is the home of big hailstorms and of big tales concerning them. Many of these storms have cost from half a dozen to a dozen human lives, one is supposed to have killed 84 people, and another is known to have killed three times that number. It appears, also, that Indian hailstones assume remarkable sizes, but it is not necessary to take too seriously the records of four cases that Dr. George Buist, F.R.S., reported to the British Association in 1855.

"One," he says, "near Seringapatam, in the end of the eighteenth century, is said to have been the size of an elephant. It took three days to melt. In 1826 a mass of ice nearly a cubic yard in size fell in Khandesh. In April, 1838, a mass of hailstones, 20 feet in its largest diameter, fell at Dharwar. On May 22, 1838, after a violent hailstorm 80 miles south of Bangalore, an immense block of ice consisting of hailstones cemented together was found in a dry well."

Dr. Buist recognized the fact that in all four of these cases the icy masses must have been aggregations of numerous hailstones frozen together, but he seems to have believed that in some cases the coalescence of the stones

might have occurred in the midst of a vortex or whirlwind before the hailstones reached the ground. This idea can hardly be entertained at the present time. It is safe to say that, if blocks of ice of the sizes reported were actually found after hailstorms, they were formed by the freezing together of hailstones lying closely packed together on the earth.

Nearly all records of exceptionally big hailstones are vitiated by some degree of uncertainty as to whether the reported masses of ice fell as such or were formed by coalescence after falling. So far as I am aware, the biggest credibly reported object that, from its appearance and the circumstances of its fall, may be safely assumed to have been a single hailstone was one that fell through the tile roof of a house in the village of Heidgraben, Germany, August 19, 1925. The stone was picked up on the floor of the upper story and measured, and the dimensions were found to be 9.8 x 5.5 x 4.7 inches. Unfortunately it was not weighed. If it had consisted entirely of ordinary ice its weight would have been about 4½ pounds, but a hailstone is composed partly of snow-like ice, containing much imprisoned air, so that it is less dense than pure ice and the actual weight must have been considerably less than this.

Pound and a half stone

The biggest hailstone thus far on record for the United States fell at Potter, Cheyenne County, Nebraska, July 6, 1928. It was approximately spherical, and when broken open was found to consist of concentric layers of alternately clear and snowy ice around a common center, showing that it was a single stone. It was 17 inches in circumference and weighed a pound and a half.

Since, as I have stated, a hailstone grows gradually in the air in the course of its upward and downward journeys, the size it eventually attains depends upon its density, its shape and the strength of the vertical air current that supports it just before it falls to earth. Judging from the meager data we possess concerning the maximum violence of thunderstorm updrafts, it would seem that something less than five pounds is the extreme possible weight of a hailstone, while a two-pound hailstone would deserve a place in a museum if it could be preserved there.

There is a proverb in eastern Europe that

says: "Hail brings not hunger." This refers to the fact that although, where hail falls, the crops may be annihilated, the damage is never so widespread as to cause a general famine. A hailstorm is always confined to a relatively small area—much smaller than that of the thunderstorm of which it is an episode—though its narrow track may be scores or even hundreds of miles in length. Thus it happens that although a great many destructive hailstorms occur every year, the majority of human beings never experience one in the course of their lives.

Another result of the sporadic and local character of hailstorms is that, though statistics of hail occurrence are collected in most civilized countries, many of these storms fail to be recorded. In the United States the Weather Bureau collects reports of hailstorms from something like 5,000 observers and obtains many additional reports from press dispatches, which are carefully checked up at the various "section centers," where climatological data are assembled.

Damage from hailstorms

The Bureau has averaged the data of damaging hailstorms and published it in chart form. In this chart the country is divided into equal sections 100 miles square (area 10,000 square miles), and figures show the average annual frequency of damaging hailstorms within each of these sections.

The largest figures, showing from two to between four and five storms a year, are found in an irregular belt that includes Kansas, Iowa and parts of Indiana, Ohio and southern Michigan, while in much of the Southwest the average annual frequency is recorded as zero, though there are only minor areas in which no damaging hailstorm was observed during the entire twelve years. There is no place in the United States at which the average interval between damaging hailstorms does not amount to several years.

According to an estimate that has become rooted in statistical literature, though it is probably much too small, hail causes throughout the world losses averaging about \$200,000,000 a year. In the United States an estimate by V. N. Valgren, of the Department of Agriculture, based upon an 11-year record, indicates that the losses on ten leading agricultural crops of this country—viz., wheat, corn,

oats, barley, flaxseed, rice, potatoes, tobacco, hay and cotton—average \$47,500,000 a year. In 1915 the losses on these crops totaled \$69,000,000. The same authority estimates that hail damage to crops and property of all kinds in the United States amounts, on an average, to at least \$75,000,000 a year.

A \$5,000,000 hailstorm

In 1928 there were two hailstorms in the State of Kansas that injured crops to the extent of \$3,000,000 each, and on August 18, 1925, a single hailstorm is supposed to have cost the farmers of Iowa about \$5,000,000, besides doing damage to the extent of \$500,000 in the adjacent State of Illinois. No part of the country east of the Rockies is exempt from these disasters, and they occur occasionally even in the Far West. Fresno, California, had a \$50,000 hailstorm on October 5, 1925. What ruin hail can accomplish in New England is illustrated by the million-dollar hailstorm in the tobacco-growing region of Connecticut on August 1, 1929.

That hail can work huge havoc in a city as well as in the country was shown in the case of the famous Dallas, Tex., hailstorm of May 8, 1926—the most destructive that has occurred thus far in any of our cities. The total damage in and about Dallas was estimated at \$2,000,000, and the brunt of the destruction was experienced in the business center of the town. Here the hailstones in many cases were three inches in diameter. Tons of ice fell on streets and buildings during a period of fifteen minutes. Not only were thousands of windows and skylights broken, but roofs of all kinds were wrecked to such an extent that the Mayor issued a proclamation authorizing owners to make needed repairs without first getting the usual building permits. Street lights and electric signs were shattered, and there was the usual riddling of greenhouses. The distinctly modern note of the disaster was the immense amount of damage done to automobiles, estimated at more than \$100,000.

How the ancient Greeks attempted to keep hailstorms from devastating their crops and vineyards is told in Seneca's "Quæstiones Naturales." The town of Cleonæ, in Argolis, he says, employed watchmen to give warning of the approach of hail clouds, which were recognized by their color. When the alarm was sounded people sacrificed a lamb or a pullet;

whereupon, it was alleged, the threatening clouds changed their course. Those who had no animals to sacrifice scratched their fingers with a sharp stylus, and this was supposed to be equally efficacious—as it undoubtedly was!

In the days of Charlemagne European peasants set up tall poles in their fields bearing at the top strips of parchment inscribed with incantations against hail.

Various charms are still employed in rural Italy to avert hailstorms. Professor Giuseppe Bellucci tells us how, in Umbria, the peasants on Palm Sunday attach to the tops of trees adjacent to their fields consecrated olive branches or bits of charred wood from the Yule log. In some districts they spread ashes from the Yule log tree on the fields in the shape of a cross, or hang amulets and religious emblems of various kinds on the trees, or ring little silver bells—all to keep away hailstorms.

Quaint machines to prevent hail

In the early years of the present century much was heard about two contrivances widely employed in Europe, especially by vine-growers, for the purpose of preventing the destructive effects of hail. One was the hail-rod; known in France as the "electric Niagara." This was merely an extra large and lofty lightning-rod. It was supposed to draw off electricity from the storm clouds and thereby—though nobody ever explained why—to prevent hail from falling in its vicinity, or to render it soft and harmless when it fell. Many hail-rods were erected in France under government auspices, but they now appear to be completely neglected and forgotten—as they deserve to be. They were perfectly useless.

The other equally futile device was the hail-cannon; a special form of mortar, which discharged a whirling ring of smoke and gas but no solid projectile. Thousands of these cannon were used in Austria, Italy, France and elsewhere. They are now nearly obsolete, but they have been replaced in many regions by the hail-rocket, which bursts high in the air and hence is alleged (especially by its manufacturers!) to concentrate its effects where they will do the most good. The truth is, however, that the rocket bursts far below the level where hail is formed, and that, no matter where it burst, it could not conceivably affect the formation or the fall of hail.

Still another delusive contrivance is the hail-kite, invented in Russia. This is really an assemblage of box-kites, carrying sirens, which are operated electrically from the ground end of the kite wire. They emit a loud continuous note, and the resulting vibration of the air is supposed, in some miraculous way, to nip the hailstorm in the bud.

A storm that changed a king's mind

A hailstorm that played an important part in history occurred in April, 1360. The English had long been at war with the French. Edward III, after an unsuccessful attempt to take Paris, had withdrawn his army toward Chartres. The French offered to negotiate peace, but the English king was stubborn. Then came the storm, which is thus described by Froissart:

"During the time that the French commissioners were passing backwards and forwards from the king to his council and unable to obtain any favorable answer to their efforts, there happened such a storm and violent tempest of thunder and hail, which fell on the English army, that it seemed as if the world were come to an end. The hailstones were so large as to kill men and beasts, and the boldest were frightened. The king turned himself toward the church of Our Lady at Chartres, and religiously vowed to the Virgin, as he has since confessed, that he would accept terms of peace." The result was the Treaty of Brétigny.

The chronicles of the time place the English losses from this storm at 1,000 men and 6,000 horses; probably an exaggeration.

Another hailstorm that lives in history is the one that happened in Europe on July 13, 1788. Beginning in the center of France in the early morning, it passed northward in two parallel bands, about twelve miles apart, crossed Belgium, and finally died out in Holland in the afternoon. The western band was about ten miles wide and 420 miles long; the eastern, five miles wide and nearly 500 miles long. Profound darkness preceded the passage of the storm. The hail lasted only seven or eight minutes at any one place.

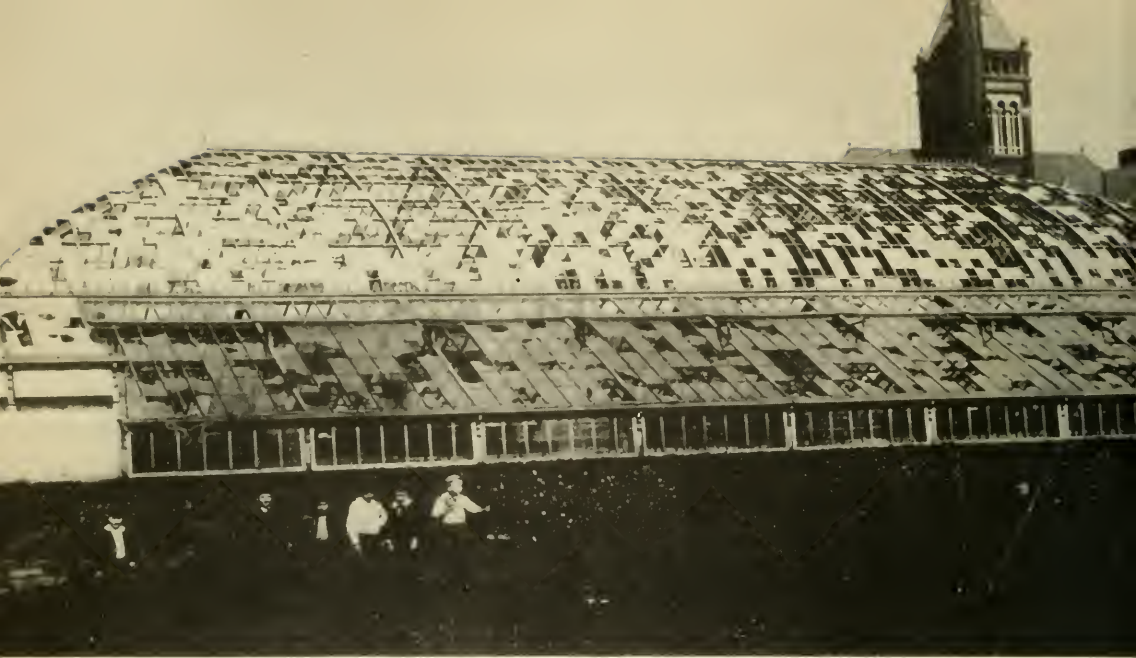
No less than 1309 communes in France suffered from this visitation, and the total loss was nearly \$5,000,000. It is said that the distress occasioned by the storm hastened the outbreak of the French Revolution.

Ice from the Thunderclouds

May time in Omaha: when snow plows became "hail plows." Accompanied by torrential rains, hail flooded whole sections of the Nebraska city, causing disastrous loss of property on May 18, 1936

Photos from Omaha World-Herald





C. F. Talman, U. S. Weather Bureau, Washington, D. C.

(Above) Greenhouse glass pays huge yearly toll to hail: this Pittsburgh storm smashed tens of thousands of dollars in window panes

(Below) Devastation in an orchard: the whole top is battered off this Leesburg, Virginia apple tree



Photo from U. S. Department of Agriculture



Photo U. S. Geological Survey

(Above) Shell holes of the frozen blast: impressions of hailstones in soft mud. Similar prints formed in bygone geological ages are

today preserved where mud has become stone (Below) Icy "boll weevil": hail-ruined cotton plants stripped of their leaves

C. F. Talman, U. S. Weather Bureau, Washington, D. C.



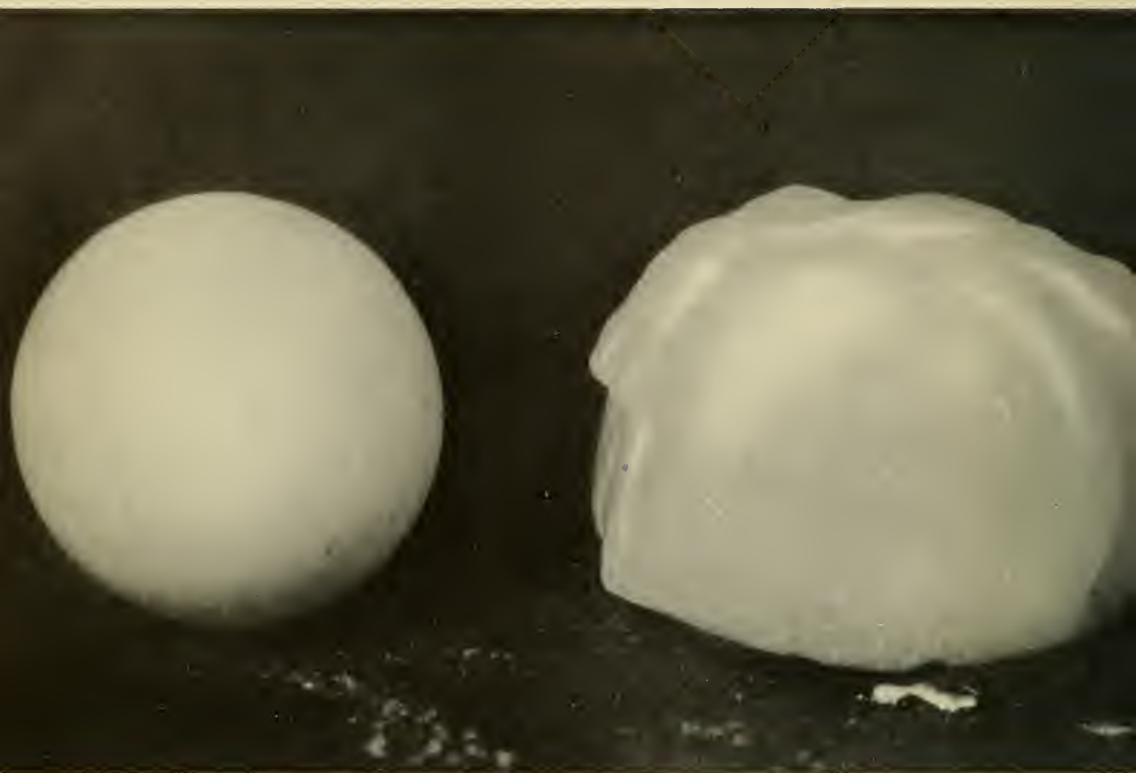


Photo Lynn Acutt, Durban, South Africa

(Above) Big as a tennis ball: actual specimen of the hail that fell at Durban, South Africa, June 24, 1929, compared to a standard tennis ball. Storm-damage estimated at £750,000



(Right) Hailstones laugh at shingles: a typical scene after the great Dallas, Texas hailstorm of May 8, 1926

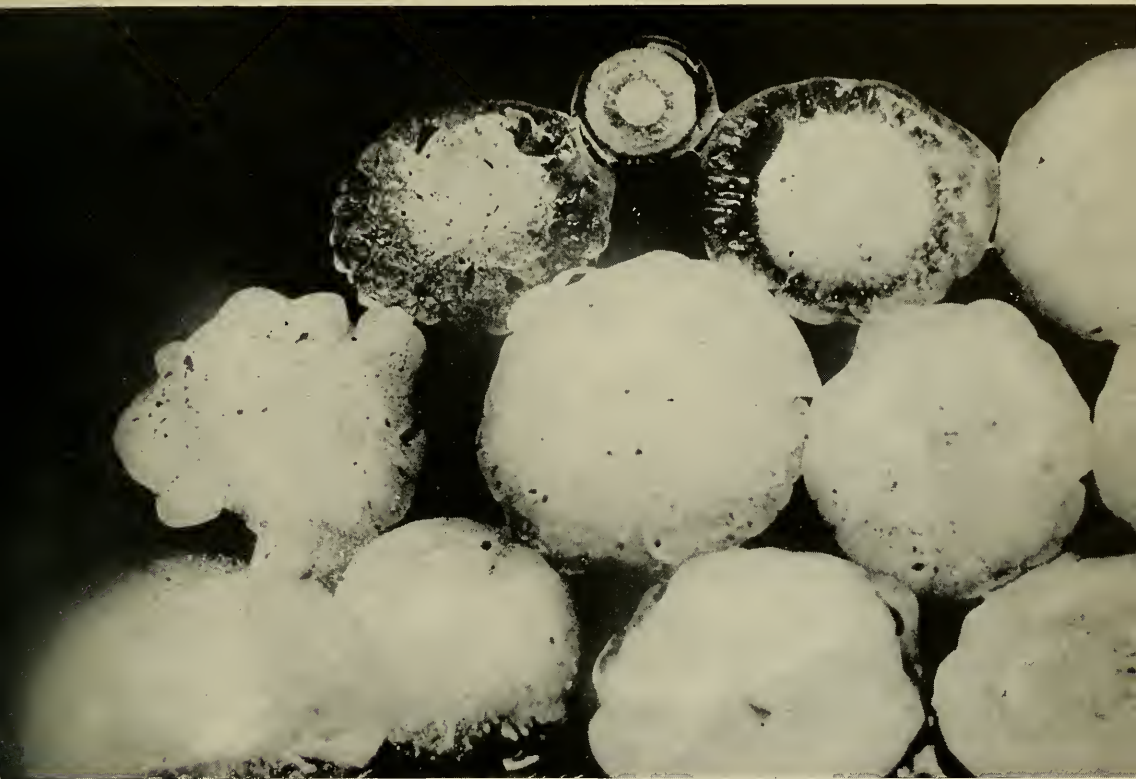


Photo by H. Metcalfe

(Above) Bullets from the sky: actual size photos of hailstones showing their onion-like layers, a formation produced as they are tossed through different air strata of varying temperature

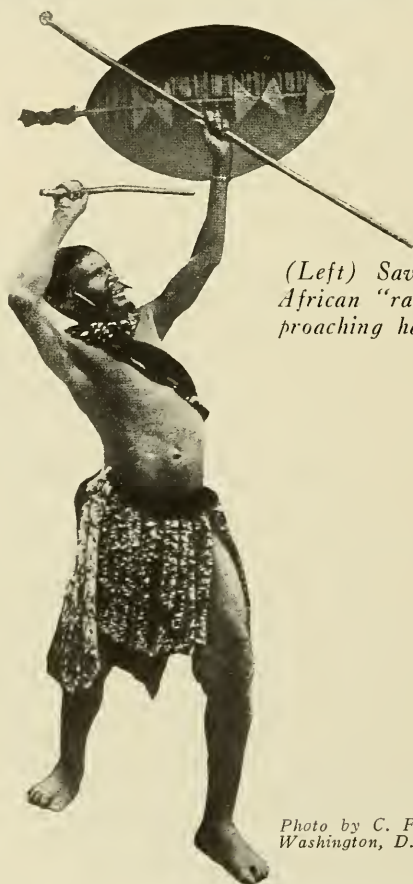


(Left) Riddled automobile roofs: mementos of the Dallas storm, probably the most destructive that has ever ravaged an American town



C. F. Talman, U. S. Weather Bureau, Washington, D. C.

(Insert) What hailstones did to a watermelon. (Background) A futile attempt to "bomb-proof" a Connecticut tobacco field: loosely woven canvas ripped by the devastating pellets



(Left) Savage versus hail: A south African "rain doctor" fighting an approaching hailstorm

Photo by C. F. Talman, U. S. Weather Bureau, Washington, D. C.

(Right) When the "hail-shooting" mania was at its height. An exhibition of the hail cannon at Padua, Italy

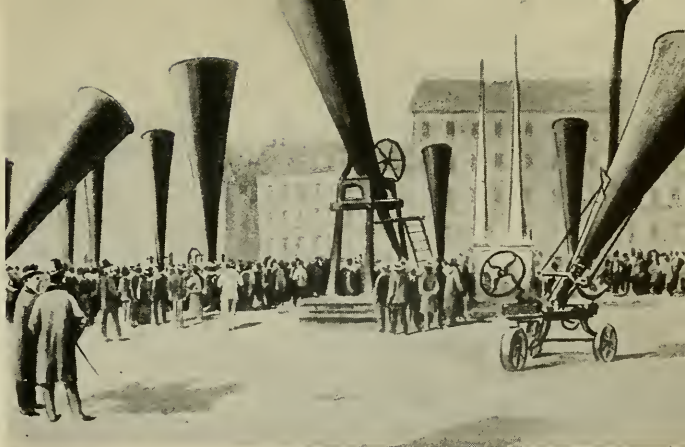


Photo by C. F. Talman, U. S. Weather Bureau, Washington, D. C.



(Left) Man's futile retaliation: cannonading the clouds. A counter-barrage method of "protection" formerly in high favor in the old world. (A painting by Jules Guerin)

Photo courtesy Everybody's Magazine



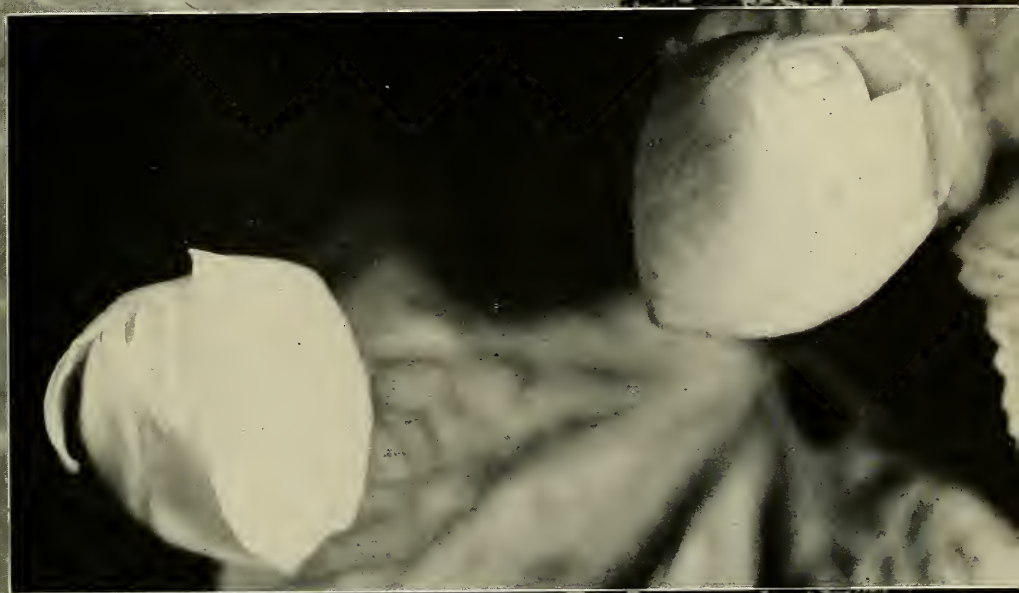
Flowers that “Go to Sleep”

AN UNUSUAL SERIES OF PHOTOGRAPHS BY FRANK S. GEHR

People do not usually realize the extent to which common flowers close at night and open again with daylight. The upper picture shows two yellow tulips as they appeared in the middle of the day, whereas the one opposite it on the right-hand page shows the same flowers closed at night not many hours later

Although temperature and moisture have some effect, sunlight is the most important factor in the strange movements which flowers undergo. The red oriental poppy, illustrated below, is one of the flowers that “go to sleep” when it is dark, as you can see from the photograph opposite taken at night







*(Above) A wild morning glory "awake" in the sun
(Opposite) The same flowers "asleep" at night. A number of morning glories only open for one day*

*(Below) A fringed gentian in daylight
(Opposite) The same flower as it appears at night or on a dark day. The movements of plants can be stopped by anaesthetics like ethylene, the constituent of illuminating gas, of which only 1 part in 1,000,000 is necessary*







The African daisy in the above photograph is open because the sun is shining on it; but when photographed at night by flashlight the flower is seen to have closed completely

(Below) White crocuses in sunlight

(Opposite) At night the photographer finds them "sleeping." There are other flowers, however, which reverse the movements shown in this series, opening at night and remaining shut during the day





José — 1936

Further adventures of a little animal whose only friend was man; the coati which won a place on the American Museum's expedition at Barro Colorado

By FRANK M. CHAPMAN

*Curator of Birds, American
Museum of Natural History*

[THE STORY SO FAR: In December, 1934, this racoon-like little animal met and won the friendship of Dr. Frank M. Chapman on Barro Colorado Island, in the Canal Zone. Doctor Chapman created much interest in José among readers of NATURAL HISTORY when he recorded his subsequent relations with this wise and appealing creature in the April, 1935, issue of the magazine. He showed José to possess extraordinary intelligence, expressed chiefly through his remarkable sense of smell.

Like other animals of his kind he lived alone until, prompted by the developments of the annual mating season, he went to the forest to fight for a mate. After an absence of about two weeks he returned from his adventures minus an eye and an upper lip and with various other wounds. Fed by members of the Barro Colorado staff he survived the summer and returned to Doctor Chapman's care the following November.

In the present article Doctor Chapman continues the story of José's life until they again separated in April, 1936.]

AFTER my departure from Barro Colorado in April, 1935, José was adopted by the laboratory family. Possibly it would be more accurate to say that the family was adopted by José. At any rate, seven months later I found him occupying much the same position as a household cat, notoriously a spoiled creature of independent ways.

Bananas, please!

He had established his headquarters at the entrances to the laboratory and kitchen, digging a slight hollow in the earth beneath the water tank in which at times, he rested. From this retreat, when hunger prompted, he issued to hold up whoever chanced to pass for food,

meaning always bananas. His request was wordless but made with unmistakable motions as, on his hind legs, he came confidently forward. If no fruit was forthcoming he retired; if it was held beyond his reach, he did not hesitate to climb for it and the marks of his claws on one's legs bore evidence to their sharpness and the strength of their owner's grip. This experiment was not repeated.

Weight no handicap

José had not been able to replace his injured eye, but his upper lip was in large measure restored, leaving a scar visible only to those who looked for it. Of his numerous bodily wounds there was no outward evidence while his general physical condition bespoke leisure, repose, and abundant food. José's figure had indeed lost the slenderness of the wild individuals of his kind. He was, unquestionably fat and showed a marked disposition to sit or lie down when not in motion. I ended this degrading life of luxury by restoring the feeding-tray on the trolley from my balcony to the forest as José's source of food. It was believed by those responsible for José's increase in weight and apparent immobility that his avoirdupois would prevent him from performing the acrobatics which had so distinguished him the preceding spring. They were mistaken.

Finding that his demands for food were no longer honored José soon accepted my invitation to return to the scene of our first meeting. There he found no bananas offered him from indulgent hands but only the scent of bananas proceeding from places beyond his immediate reach. Seven months had passed since

he had been confronted by this situation. Would memory assist him in meeting it or would he employ original initiative?

The odor of a peeled banana on my balcony rail evidently attracted his attention and, nose up, he "tried the air" in familiar fashion. At once he came to the balcony floor, leaving it and returning several times before he located the food on the rail. This was distinctly below his average performance of the preceding spring. And twice he visited the rail before he discovered a second banana on the crossbar of the three-foot upright to which the feeding-tray trolley wires are attached. This he climbed with some little effort, remaining on it to eat his reward.

He seemed to be aware of still further food in the feeding-tray about eighteen feet distant and started to walk the trolley wires toward it but after one step returned to the cross-piece and descended to the ground. Thirty minutes later he returned without hesitation for a fresh piece of banana on the cross-piece but made no attempt to go to the tray. In another half hour he again came to the cross-piece for the always acceptable banana. As before, he started on the wires for the tray but after a foot gave it up and retreated to the ground. But there was still banana in the air, and with characteristic coat persistence José soon returned to the cross-piece and finding no more banana there turned his whole attention toward the tray, where a lone banana remained. For the first time he now encountered the cord by which the tray was pulled to and fro. It was of the same kind as that used in various banana experiments with him the preceding spring and its touch seemed at once to arouse memories of bananas which had then always been attached to it. At once he pulled it vigorously and, when this brought no result, as before he bit it until I interfered.

This ended the tests for the day. They showed plainly that José was far from losing either his mobility or initiative and that when the right cord was touched his memory was responsive.

Walking the wire

The following morning, November 30, at 10:50, José returned, climbed up the steps of the balcony where I was sitting, and came to me obviously for food. I referred him to the crossbar and tray where bananas awaited him.

But for reasons, if any, known only to himself, he descended the two steps to the ground and went directly to the woods thirty feet away. Passing the tree to which the far end of the trolley wires are attached, and which was still encircled by the impassable zinc "rat-guard," he started to climb the following tree but after ascending several feet slipped back to the ground. "Ha ha," I said, "it's too much for you," but without pause he continued to the succeeding tree. Evidently it had required only two or three steps to show him that this second tree was not the right one. But on the third tree he obviously felt at home and confidently climbing to the point where it met the "trolley tree" he crossed over, descended that tree to the wire and without a moment's pause walked out on one wire, resting his tail on the other, to the tray ten feet away. He acted as though wholly accustomed to the maneuver, ate his banana while resting easily on the tray, and then at once retraced his route to the ground. On this, his first trial, therefore, with only the slight, quickly corrected slip of starting up the wrong tree, he remembered his indirect route to the tray and followed it without difficulty. He did not, however, seem to climb as easily as in the preceding spring and, when ascending, stopped three times to rest a few seconds while panting rapidly. But within a few days he was an agile as ever. Why he should have balked at the wires the first day and treated them so familiarly the next I am unable to say. Possibly because at the forest end of the route to the tray they formed a regular part of an unbroken succession of events, while the balcony route was broken by various incidental experiences.

José's rivals

These two days served completely to restore the relations with José which had been broken by my seven months' absence. Meanwhile his existence had become somewhat complicated by the appearance of several rivals for our favor. These animals, known as Miguel, Julio, and Antonio, observing the ease with which José supplemented the food supplied by the forest, had not hesitated to advance their own claims for bananas and each found one or more patrons among the workers on the island. But although these later comers were still fed at the entrances to kitchen and laboratory they did not hesitate to poach on

José's preserves at my balcony. When he was present they did not venture to trespass, for they apparently recognized his seniority, and, in a swinging gallop, always retreated before him. But José sometimes had affairs of his own to attend to and when absent these trespassers soon also learned to reach the various places in which I offered bananas to possible bird visitors.

Within an hour after the feeding-tray had been cleared of the enveloping luxuriant vegetation of the wet season and supplied with a banana, it was visited by doubtless the same tanagers that had frequented it the preceding spring. They were soon joined by two blue tanagers and an adult female and young male of our summer tanager, wintering here. At times all three species were present together, an apparent recognition of family relationships or, at least, an exhibition of similar tastes, which resulted in a singularly beautiful picture. But if I expected to continue to receive these birds as guests I must find some way of protecting their dining-table from an intruder who would not hesitate to make them part of his meal. I therefore returned to the problem of making a coati-proof dining-table for birds. If a tray on two trolley wires could be reached so easily, possibly a tray on a single wire would be beyond a coati's powers. Two wires supplied one for the feet and one for the tail, making a stable means of locomotion. But with the tail support removed, Mr. Coati would find himself strictly without visible means of balance. Moreover, recalling something about the super-skill required to walk a "slack rope," I resolved that as a final deterrent my wire should be of the slackest. So I dropped it nearly four feet in sixteen, or to an angle of about twenty-three degrees, confident that the food-tray was now for flying creatures only, birds by day and bats by night.

With the greatest of ease

But José mastered the new contrivance at the first attempt. It is true his little journey was ended so hastily that the tray turned over with him. But he lost neither his head nor his footing while the banana was grabbed as it swung above him and devoured before he resumed his journey upside down and returned to the tree somewhat winded but experienced. After lunch the journey was repeated with

everything under control and it was evident that while I had added to José's skill I had in no way reduced his sources of food. Thereafter, I tried to keep the tray so well supplied that there would be enough bananas for both birds and coatis. But I did not confess myself defeated. I still thought that there must be places open to winged creatures and closed to quadrupeds and I looked to the trees.

Tying a banana at each end of a three or four foot string I tossed them to the outer branches of the trees over my balcony. Some barely caught and hung dripping from the terminal twigs as though they had grown there. Even the tanagers could reach them only while on the wing. And the coatis? I must confess that they made me feel as though I were lacking in both experience and imagination. For them I had merely substituted a banana for an almendro nut. They climbed down the branch as far as possible and if they could reach the string pulled it in with the banana at its end. Just, indeed, as they had pulled in the bananas attached by strings to the feeding-tray. If they could not reach the string they broke off the limb to which, directly or indirectly, it was tied and pulled that in. One pair of bananas landed at the extremity of a far-reaching balsa limb twenty feet above the ground and twice that distance from the trunk of the tree; but they were unerringly located and collected. Not one banana escaped.

Making it more difficult

I deferred making the final experiment that occurred to me. Not because I believed that it, too, would fail, but because of its general inappropriateness. Taking a leaky zinc wash-tub I nailed it upside down on a stout pole about eight feet long, of which two were firmly set in the ground. Bananas were placed on its upturned bottom and there, at least, coatis tried in vain to get them. One after another the younger animals climbed the pole to the heart of the tub and dropped back to earth. But they were far from discouraged, and repeated pawings at the rim of the tub finally so weakened its fastening to the pole that it swung to and fro and a more than usually agile coati succeeded in getting his claw over the rim and, in some inexplicable way, hoisted himself up on to the bottom. In the end, therefore, not even the tub was immune and at this point I

abandoned further attempts. The coatis won. The birds must take their chances. I would supply the bananas.

Meanwhile, I found that coatis were not restricted to a fare of bananas. With the ripening of the almendro nuts late in January they ascended the trees that bear them and no nut was too remote to escape picking. Only the thin rather acrid outer covering was eaten, then the nut was dropped for the peccaries, pacas, agoutis, and squirrels. This is a favorite food but even at the height of the almendro season coatis varied their fare. I was seated on my balcony one afternoon early in February when an unrecognized coati started sniffing about on the hillside near me. In a moment he was evidently assured that he had found what he wanted and began to dig. It was not a casual digging. It was a frenzy of digging. The earth, which had been in position only ten years, was comparatively loose and with stones nearly five inches in diameter it rose in a continuous eruptive shower that rumbled down the hill. Within five minutes the animal was lost to view in his own excavation. At the end of that time he withdrew his prize—a tarantula which, barring two claws, was devoured on the spot. The hole was thirty-two inches deep and fourteen inches wide at the entrance.

Fond of eggs

There is a general, and I think, warranted belief that coatis are destructive to birds, their nests and contents, but beyond their capture of a paroquet at the laboratory I know of no instance of their bird-eating. As a means of gaining more information we therefore placed two hens' eggs where they would be seen by wild coatis. Their action was prompt and definite. One egg was soon carried unbroken to a distance of a hundred feet before eating, the other was devoured on the spot. The top was neatly removed from each egg and the exposed contents then lapped up as though from an egg cup. One could imagine that such skill could be acquired only by experience, perhaps with tinamous' eggs.

To vary this test I hid two eggs at different spots in the grass on the hillside near my balcony. One egg was not handled and was placed with the aid of a tablespoon attached to a long pole. It was never visited. The other was hidden by hand and visited frequently.

Neither egg was taken and the experiment is mentioned only to suggest that it be repeated.

That an animal so fond of bananas should also have a pronounced if not indeed passionate liking for tarantulas helps prepare us for the statement that coatis are also fond of bats!

When at night I explored the forest from my balcony with a powerful searchlight, its rays were often thronged by bats of several species. Some were fruit-eaters and in a steady line came for a bite of the banana in my food-tray. Others appeared to be insect-eaters, darting erratically here and there. To capture specimens for identification, like a great spider I spun my web, in the form of an Italian bird net, thirty feet long and six feet wide, between me and the forest. The bats caught were presumably fruit-eaters, which apparently lack the sensitiveness that aids insect-eating bats to avoid objects when in flight. But if they became entangled in a part of the net within reach of tree or hillside only the wings were left for me while a coati appropriated the still living body. I therefore abandoned this form of collecting and restricted further experiments on the food of coatis to cake and candy, both of which they refused. Of bananas, however, they never tired and even the ripest specimen was acceptable.

While José seemed in perfect physical condition it is clear that at the end of January, 1936, as the annual mating season approached, he was not as well prepared for its tests as he had been the year before. He was much overweight, a diet of bananas was doubtless not as strengthening as one more varied and more difficult of acquisition, and he was minus the eye lost in last year's mating contests. Consequently, if there is any truth in the theory that an animal physically below par is seriously handicapped in the struggle for existence, José entered the lists of the 1936 mating season under a marked disadvantage.

José's marital expedition

The result supported the theory. The date of his return from his marital expedition demonstrated the regularity of his physiological cycle. It will be recalled that in 1935, after an absence of two weeks, he returned to the laboratory on February 11. In 1936, after a somewhat briefer absence, he returned on Feb-

ruary 10. In 1935 he was minus an eye and an upper lip and plus countless body wounds, some of major importance. In 1936 he had lost the use of a foot, the remaining eye was badly injured, a former shoulder wound was reopened to a length of about four inches and width of over one, and there was literally not two square inches of his body that did not show the mark of claw or tooth. José was, indeed, such a pitiable looking object that the men urged me to end his suffering. The injury to his foot was the most serious. It robbed him not only of an organ of locomotion and means of securing food, but of a weapon. The foot was swollen, its claws bent backward, and the care with which it was held from the ground indicated that it was painful. Above all, José's spirit seemed broken. He had lost his distinguishing confident attitude toward life, and after eating three bananas hobbled back to the woods, his lowered tail, like a flag at half-mast, dragging behind him.

His spirit broken

The preceding year, after returning from his campaign of conquest, José had to contend only with his wounds. We supplied him with food and in the vicinity of the laboratory he found safety from his enemies. Meanwhile other coatis of his sex have made friends with us if they have not with him. If earlier in the year they interfered with what he evidently considered his prior rights, he exhibited his authority in a manner not designed to promote his popularity. Now it was their turn and they knew it; so did he. When in the morning he returned for his daily bananas he moved cautiously, advancing only after careful inspection of the surrounding territory. Even when eating he was constantly on the alert and would suddenly stiffen to attention if he fancied he detected the presence of an enemy. This act always impressed me as an exhibition of intelligent discrimination. Did he or did he not hear or smell one of his own kind?, it seemed to say. If he concluded that he did not, he resumed eating, but if he became convinced that an enemy was nearby, the half-eaten banana was dropped abruptly. There was no questioning growl, no "trying of the air" with that sinuous nose, no querulous twisting of the snake-like tail; without a word or a moment's pause, tail dragging, he loped away in complete and shameless confession of his impotence.

But notwithstanding his evident desire to avoid further conflict, at least until he was better prepared to defend himself, it was apparent that he did not always escape. Often he showed new and more or less serious wounds and it was a question whether in spite of our care he would survive the attack of his foes. They showed him no mercy and about the laboratory, at least, appeared to be almost constantly on his heels. He could find no place where he was secure. March 3, for example, after eating four bananas on my doorstep he entered and crossed my room as though he were considering it for a retreat. But something, perhaps the confinement of four walls, evidently worried him. I stood one side to let him choose his own resting-place but he seemed in constant fear of an assault from the rear and returned to the door. Crossing the balcony to descend the steps he stopped suddenly head down, body trembling, as though about to collapse. Twenty feet away a coati was coming slowly toward him. José made no attempt to escape. He seemed to be ready to surrender. The approaching animal was one of the younger ones that he had dominated earlier in the season. José, I felt, would be helpless in his claws, so I drove him back to the forest and tried to induce José to return to my room. But this was a form of retreat he did not understand. So he pulled himself together, went down the steps and slowly climbed the hill away from his enemy.

A fierce encounter

Three days later an animal that I recognized as Miguel, after I had driven him off several times, charged José while I was feeding him at the laboratory door. The attack was made from the rear with a sudden, deadly ferocity and José responded with a power and drive that we had not supposed remained in his torn body. Miguel, evidently as much surprised as we were, quickly gave way and we completed his rout. Then to illustrate that such little incidents are all part of a coati's daily life, José, with complete composure, returned to the banana he was eating from my hand. I showed far more excitement than he did.

Meanwhile José was making a marvelous recovery from his countless wounds. What is it, one asks, that keeps his scratches, cuts and

gashes free from infection? Certainly the tongue, with which alone they are washed, bears no visible healing ointment but carries the essence of one wound to another, and all alike are without traces of pus or inflammation. How places beyond the reach of his tongue were treated I do not know.* His foot alone seemed inflamed and sore but here there had been an apparent tearing of ligaments which called for replacement of claws, and possibly bones, before healing, and while progress was made it was slow. It was not until March 11 that I saw him attempt to use his injured foot, other than to walk on it. Then he dropped a banana half-eaten and sniffing along the hillside made a half-hearted attempt to unearth a tarantula. The act seemed to say "I'm tired of bananas; give me some real coati food."

During this period of daily visits José and I established closer relations than had previously existed between us. Hitherto I had been merely a source of bananas of which my hand was the container. Now he acted as though there was something in our relations besides bananas. He recognized my voice and responded to his name, coming to me, when hungry, from distances up to a hundred feet. He acted as though at home in my study where, his hunger appeased, he spent hours, chin on paws, comfortably sleeping in evident belief that he was safe there. Thus he clearly looked to me for protection as well as for food.

José's trust

When feeding he no longer grabbed the banana from my hand and made off with it but gently put his paws on mine and with apparent care to avoid injuring me with either claws or teeth, ate slowly. In short, within limitations, José and I had acquired confidence in one another. Knowing that since he had left his mother's side he had never been touched except with intent to kill, I made no attempt to caress José, nor did I expect anything like a purr or friendly tail-wag from

him. To be known when we met away from the laboratory was the extreme form of recognition I expected.

On the morning of March 29 I met him near the lake digging with one foot for tarantulas. He stopped work as I approached and came toward me with an expression which I interpreted as saying: "You haven't a banana about you, have you?" But before I could explain that I had not expected to meet him, etc., he smelled his own reply and returned to his digging.

Two days later, knowing I would pass this way, I placed a small banana in my sack on the chance of meeting José again. Sure enough, there he was hopping down the hill toward me, the injured foot held high. This time his expression read "What about that banana?" and I replied "Well, what about it, José?" He sat there on his haunches waiting for me to make the next move, but as I remained motionless, he came forward, went direct to the bag at my side, extracted the banana and ate it at my feet. He did not ask for another, for he knew as well as I that there were no more. Then he went into the forest but soon returned to hunt grasshoppers about me as though he sensed a safety zone in my vicinity.

His only friend—man

As the time for my departure at the end of April approached, José was returned to his friends at the kitchen door. New fur was sprouting from the bare patches on his body, but he could not hope for a new eye, and I doubt if ever again his foot will serve him as an effective weapon. With our bananas and his discretion he may survive until another mating season brings with it the desire for a mate and forces him to re-enter the lists. Then the loss of a foot, as well as an eye, will prove too great a handicap and José will meet the end of the male of his species. But he will have added to our knowledge of a coati's life. His sisters, in due time, doubtless had families of their own, but since reaching maturity José's only contacts with his kind have been to fight and to mate. Aside from these brief periodic exhibitions of animalism he is alone in his world. In sickness and in hunger he is dependent solely on himself. Other forms of life may serve him as food; with man alone can he hope to make friends.

*Since the above was written I have discovered the following in *Science* for June 26, 1936:

"Licking their wounds, a practice universal among animals, has good bacteriological justification, is reported by Dr. Herman Dold, professor of hygiene at the University of Tübingen. Cultures of bacteria to which saliva was added failed to thrive, while untreated 'control' cultures grew flourishing colonies of the germs. It therefore appears likely that in addition to keeping dirt and hair out of their wounds by the constant licking, the afflicted animals are also applying an effective antiseptic."

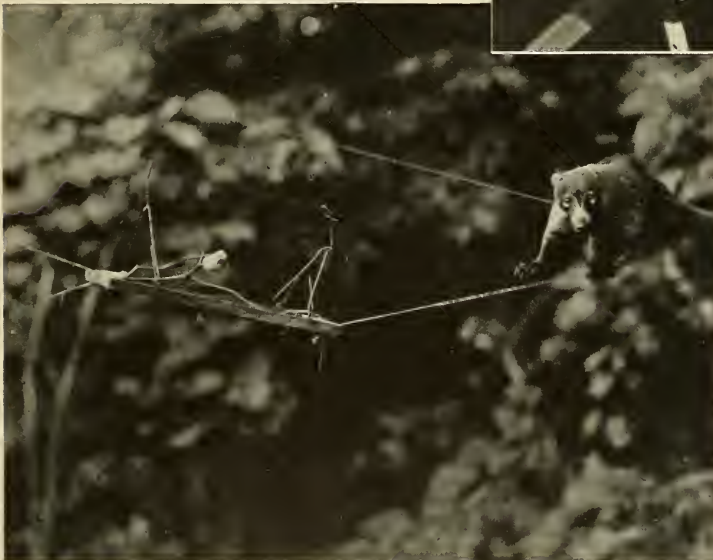
José



(Above) A portrait of the coati whose intelligent actions have for two seasons entertained the Museum's expedition at Barro Colorado near Panama: a battle-scarred veteran of the mating season, with only one good eye, a defective upper lip and a split left ear



(Right) Breakfast at the author's knee: an expression of mutual confidence



(Left) After seven months of easy living José was quick to resume his training in aerial acrobatics. Here he is shown 'tight-rope' walking to the tray which contains his favorite food, bananas

1936



(Above) José is shown circumventing the tree guard which coatis could not pass. José avoided it by coming from above, and walked the single wire to the food tray, a distance of 15 feet



(Left) Pulling a banana down which is attached to a string thrown over a single wire

In the picture at the right the single wire to which the banana was tied did not reach the ground, so José climbed out and pulled it up as shown





José's intelligence was displayed largely through his keen sense of smell. If the suspended box shown above contained a banana he would pull it up, but if it held only a stone he made no attempt to obtain it



Complete confidence in man—his only friend: José eating a standing meal at the author's doorway. His left shoulder and forefoot show some of the wounds sustained on his second mating expedition which seriously threaten his chances in the struggle for survival

The Desert Fish of Death Valley

It seemed impossible that fish could exist in a spring in Death Valley, far from the nearest water, but there they were, survivors of the Ice Age

By WILLIAM V. WARD

COULD anyone believe that there are fish in California's Death Valley? Hardly; at least no one would entertain for a moment any such thought who had gone, as a tourist, through that sun-scorched furnace-heated region where streams are unknown and where the only pools are those of bitter waters.

Thus, when I read from a newspaper a colossal story of a certain spring in Death Valley wherein live and abound a thriving species of fish, I thought that perhaps the reporter had had a slight touch of the sun. However, the article was written in so reasonable and coherent a style that it gave a suggestion of truth and most certainly provoked curiosity. The newspaper story really was not unduly exaggerated; it merely gave the surprising information that at Saratoga Springs in the southernmost portion of Death Valley, about twenty miles from the lowest point on the North American continent*, there were to be found living in the salt water of that spring, a certain species of small fish. And that was the fact which interested me, and caused me to wonder.

To bring 'em back alive

Being somewhat of a scientific turn of mind, I decided to go at my earliest convenience to Death Valley to investigate these unusual fish and to try to photograph and collect specimens of them. Then, too, perhaps I had in mind exposing as a nature-fakir the writer of that newspaper yarn. So, when time permitted, the trip was undertaken. Food was prepared for

a desert camping trip: water jars were filled, fish nets were made, thermos jugs were procured in which to place a few fish in an effort to bring back specimens alive, if any were found; cameras were loaded, and a small special aquarium was taken along in order to obtain photographs of the fish in the field in case it should be impossible to bring them out of the valley alive. Thus equipped, a fishing expedition to Death Valley was under way.

Into the desert

The springs described were found quite easily after a preliminary study of various maps and then, after arriving in Death Valley, by watching for the desert water-hole signposts which have been erected there by the United States Geological Survey. The roads leading to the springs where the fish were said to exist are clearly marked, for the springs are among the largest in the whole Mojave Desert, and they long have been noted as a camping place for desert travelers. Even the Indians had been there, as picture writings on the face of a rock wall a few hundred feet to the southeast testified.

Late in the afternoon, after a long, hot journey across the desert, the car came to a jolting stop beside a circle of reeds, surrounded by salt grass, which marked the location of a water-hole. Stiff-legged from driving, I climbed out, pressed my way through the reeds, and looked into the pool.

Wonder of wonders, if the newspaper story wasn't right! There were the fish! A thousand of them, playing and fighting in the depths of the pool. Slanting rays of light from the afternoon sun reflected themselves from the irides-

* 276 feet below sea level.

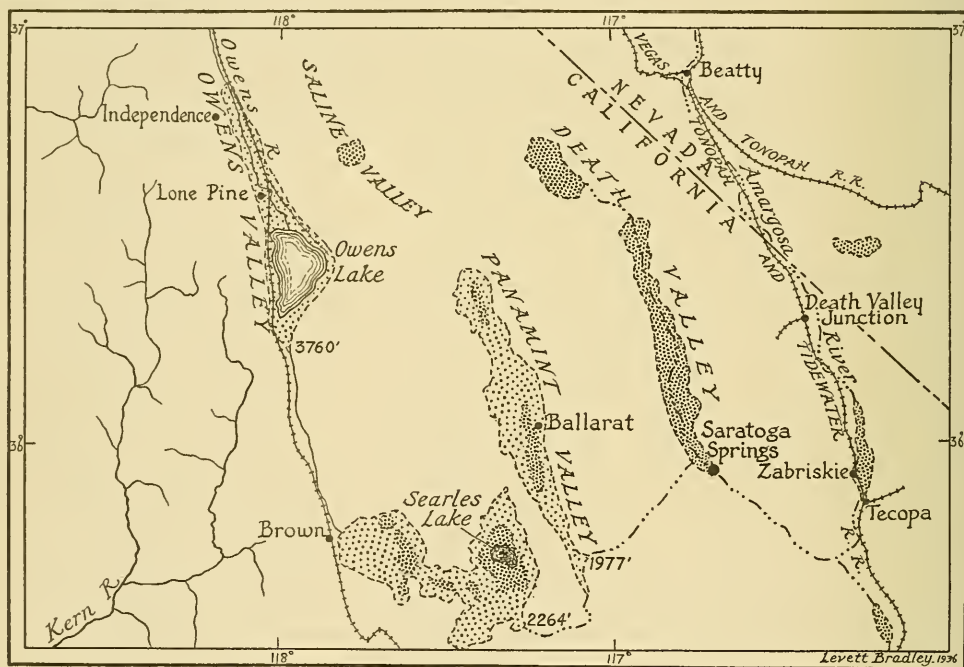
cent blue sides of the males as the fish darted in and out among the reeds and sunbeams.

The pool was oval in shape, about twenty by thirty feet, and from two to five feet in depth. The bottom was covered with decayed vegetation except in several round, sandy spots ranging from one to three feet in diameter through which the water bubbled from its underground source. As each new jet of water came in, the sand would shift, rise up in a little whirling pillar and then fall away; and ever among these swirling pillars of sand the fish were darting in and out, evidently merely to enjoy the tickling sensation of the sand.

An investigating glance around the springs showed that the one I was standing near was the central pool from which the water flowed through several small ditches, heavily choked with vegetation, to two other pools each of which was an acre or so in extent. These larger

pools were quite shallow and around their edges waded a few killdeer and a Wilson phalarope, while on the surface swam green-winged teal and western grebes. Red-winged blackbirds were at home in the reeds. The larger, shallow pools, together with the surrounding marshes and tangled ditches which connected the several pools, formed a breeding ground for the fish, the small ones of which could be seen swimming in schools close to the surface. Here in the shallow water and among the matted vegetation and algae, the young fish were able to hatch and to grow unmolested, until they were big enough to return to the central pool and cope with their vicious cannibalistic parents.

Looking up from the pools and marshes for a quick glance at the topography, one's eyes met the barren, rocky slopes of a spur of the Ibex Mountains, which border the eastern side



HOW THE FISH GOT INTO DEATH VALLEY

This map shows a vanished lake system which probably existed in Southeastern California in the glacial epoch. At that time Death Valley was presumably the overflow basin into which drained the waters from the surrounding glaciers and mountains. The fish are believed to have entered Death Valley by these waters and have survived there in the restricted salt waters of Saratoga Springs, completely

cut off from all other waters of the world and only twenty miles from the lowest and hottest place in the United States. The shaded areas were occupied by lakes of the Pleistocene epoch; and the darker shaded areas represent playas, or plains intermittently covered with shallow water. Searles Lake is not a lake in the ordinary sense but occupies a salt-incrusted surface and varies in size

(After Hoyt S. Gale, Bulletin of the United States Geological Survey No. 580)

of the Valley; while to the northward, across the dry bed of the Amargosa, one saw through a haze the snow-capped crest of Telescope Peak as it rose eleven thousand feet above the heat waves which shimmered over Death Valley. Indeed, it was a strange and picturesque setting in which to find fish; so much so, in fact, that it caused me to cease exploration for the moment to determine why the fish were there.

It was clear that they could not have come to these springs from any other pools in the region. The nearest other water was miles away; and an examination of the U. S. Geological Survey water-supply maps for the Mojave Desert showed that it would be an impossibility for the fish to travel between pools even in times of heavy rains and floods. Therefore, it seemed most reasonable to presume, as do Stanford University ichthyologists who are studying the desert fish, that the little minnows are descendants of those which once

inhabited the area at a much earlier geological period when the desert had a moist and humid climate, and when the present arid basins were lakes and the dry water courses full flowing rivers. Such a time was probably in the Pleistocene when Lake Bonneville and Lake Lahontan covered with fresh water much of the territory in the southwestern United States; and when the Mojave, Amargosa and Owens Rivers connected the present springs, dry lakes and washes in an integrated river system which drained the melting glaciers then on the nearby mountain ranges.* This drainage system is depicted in the accompanying map and diagram.

These fishes of Saratoga Springs belong to the hardy family of *Poeciliidae* (killifishes or Cyprinodonts) and are known to science as *Cyprinodon macularius*. They are known commonly as "Death Valley Fish," "Desert Minnow," and "Spotted Pursy Minnow"; and variations of the type specimen are found

* "Waters that formerly filled Owens Valley until they overflowed, flooding successively lower and lower basins, formed for a time a chain of large lakes in what is now the desert region of southeastern California. These flood waters passed from Owens Valley, the principal source of the water supply, through Indian Wells, Searles, and Panamint valleys, in each of which there was an extensive lake. Finally the waters are believed to have overflowed also into Death Valley, and there the physiographic record has not yet been completely deciphered. . . .

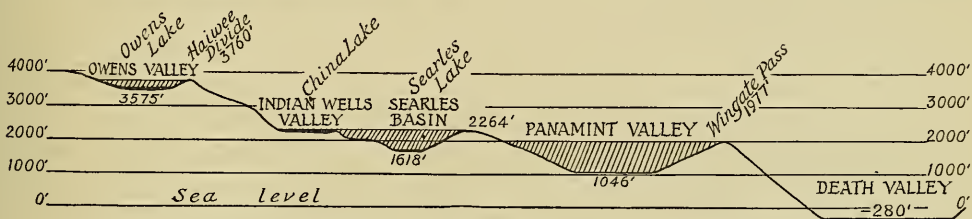
"Panamint Lake narrowed to a point at its south end, and this was not only the point of inlet for the overflow from the Searles Basin but it appears that the inlet was also near the position of its probable outlet or overflow during the period of its maximum flooding. The greatest depth of Panamint Lake was probably determined by Wingate Pass, through which an overflow is believed to have passed for

some time into Death Valley. . . .

"The final bit of evidence concerning the maximum water level of the Panamint Lake was found in the contouring and elevations in Wingate Pass, which leads from the Panamint Valley into Death Valley. These data were obtained in recent surveys for maps now in preparation. . . .

"The correlation of the Quaternary lakes of Owens Valley and similar areas in the Great Basin with the stages of ice extension in the glacial epoch rests upon general considerations, although it is accepted by most geologists. . . .

"It is stated that the greatest expansion of the waters of the Mono Basin occurred subsequent to the last extension of the Sierra Nevada glaciers. It is reasonable to assume that the other lakes of the Great Basin attained their maxima at the same time." (Hoyt S. Gale, in *United States Geological Survey, Bulletin 580*, "Salines in Southeast California," pp. 251-323.)



DEATH VALLEY AT FOOT OF FORMER LAKE SYSTEM

The isolated fish which live in Saratoga Springs in Death Valley are believed to have come at a time when a more humid

climate connected the basins shown here in profile into one system

(After Hoyt S. Gale, *Bulletin of the United States Geological Survey No. 580*)

in desert water-holes throughout the Southwest. "Death Valley Fish" seems to be quite appropriate for the specimens at Saratoga, for no other fish are found in Death Valley. They attain a maximum length of from two to two and one-quarter inches. The males have slightly barred sides which become a brilliant iridescent blue when the light strikes them at the correct angle; but at other times they appear to be plain gray, with sometimes a reddish-brown tinge when one is looking down at them in the pool. The females lack most of the iridescent blue and are a little paler than their mates, while they have vertical bars on their sides which are much more prominent than those of the males. The fish are omnivorous, eating both vegetable and animal foods. This is apparent to the observer who watches a group of them carefully eating the algae off some plants at the bottom of the pool, and then sees them make a lightning dash to the top of the pool to make short work of an unfortunate moth which chances to be blown into the water.

How to catch them

It was necessary to catch several fish for photographic purposes as well as to obtain a few to attempt to bring home for aquarium specimens. The rapidity of movement of the fishes in the water made it almost an impossibility to even try to scoop them up in the nets brought for the purpose. However, the easiest way to catch them soon was discovered. An insect would be placed on the surface of the water, and its struggles quickly would attract a number of fishes. While they were busy attacking the insect, the net would be slipped quietly beneath them and they would be captured. Then they were transferred to a waiting thermos jug to be carried home, or else placed in a small aquarium, the front and back walls of which were close together so that they would be confined in a narrow plane while their photographs were made. It was but a matter of a few more minutes to catch from eighteen to twenty fish of both sexes and of various sizes and to place them in thermos jugs for the trip home. Five or six more were caught for the purpose of making their pictures. The small glass aquarium was made ready and the fish placed in. Afraid at first, they made fairly good camera subjects as soon as they had thoroughly investigated their

new surroundings and had settled down a bit.

In sweeping the nets about the pool, it was found that fish were not its only denizens. A brown leech, of about four inches in length, was rather common, as was the yellow-bordered water beetle, *Dytiscus*. The water beetle, apparently, was the only enemy of the fish aside from the frogs. It was seen swimming constantly along the edges of the pool searching for young fish which it kills by clasping them with its strong fore-arms, while its proboscis pierces the fish's back to suck its blood.

Temperature of the water at Saratoga Springs was found to be quite high, ranging rather closely between 82 and 83 Fahrenheit, and to maintain that temperature consistently, as it is a warm spring. No doubt the temperature of the surrounding shallow pools, which are away from the source of warm water, fluctuates quite widely as does the air temperature from night to day and summer to winter. Death Valley is one of the hottest regions in the world. The minimum daily temperature in summer is rarely below 70° F. (in the shade); and the maximum may, for days in succession be as high as 120°, and the U. S. Weather Bureau has recorded an extreme of 134°. But even though the fish might be used to wide temperature changes it was deemed most advisable to transport them the three hundred miles out of the desert in thermos jugs in order to maintain a constant temperature; and in that manner all of the specimens arrived home safely.

As aquarium pets

The fish have made most interesting aquarium specimens for well over a year. Some have lost their lives through their very ardent pugilistic activities; but much of this is avoided by keeping the aquarium thickly planted. Temperature variations seem to cause no great harm other than a loss of color and vivacity. They still live in water brought from Saratoga Springs, but this has been diluted with an equal volume of tap water, thus considerably reducing the alkalinity and salinity. One looks at these little minnows pushing their way determinedly about the aquarium and knows that they are "tough" fish, as well they must be, to have survived since the ice age in a little pool in Death Valley only twenty miles from Bad Water, the lowest and hottest place in the United States.

The Desert Fish of Death Valley



Death Valley, the lowest, hottest region of the United States, might not seem a likely place to find fish. Yet the salt pool shown below is

the breeding place of myriad finny survivors of the Ice Age

(All Photos by William V. Ward)





(Left) Collecting aquarium specimens of these cannibalistic fish with bait, net and thermos jug. Insects must be placed on the water to hold their attention long enough to slip the net under them



From the shallow, marshy pools where the fish hatch they swim into the central pool shown below to wage their struggle for existence with their cannibalistic parents. It is believed that they are survivors from the Glacial Age, when the desert had a moist climate and fresh water covered much of the territory in the southwestern United States



The captured specimens were put in a thermos jug, which was later found unnecessary, as the fish are so hardy as to need no temperature protection





Photographing specimens of the Death Valley fish. A special aquarium was used in order to keep the fish in focus and to obtain true-size pictures

The Death Valley fish (Cyprinodon macularium), about three-quarters life-size. The females (left) have prominent vertical bars on their gray sides, while the male (right) is a brilliant iridescent blue with faint vertical bars



The Tragedy of the Culbin Sands

An amazing catastrophe which changed a section of the fair Scottish countryside into a miniature Sahara and made time stand still for more than two centuries

By H. MORTIMER BATTEN

IN the autumn of 1694 there occurred at Culbin, on the Moray Firth, midway between Nairn and Forres and just where the wonderful and varied River Findhorn joins the sea, one of the most curious calamities which has ever occurred in Scotland. Curious yet tragic, for in Great Britain one hardly expects the overwhelming forces of Nature to make themselves felt.

One autumn afternoon a wind sprang up from the sea bearing with it the sting of flying sand. Little was thought of it, for in spite of the wonderfully mild climate of that area of Scotland, which lies open to the sun yet is sheltered from the cold winds by the Grampian Mountains, autumn storms which piled up sandhills and caused the sea to make great inroads into the coast, were not unusual. As the wind strengthened, however, the sand thickened, and its onslaught became so fierce that laborers in the fields were compelled to leave their ploughs in the half-cut furrows, where many of them remain to this day.

The storm rises

As night came on, the fury of the storm passed all records. It was then that some of the villagers recollected that some days previously an old woman, supposed to possess the powers of witchcraft, had visited the village in search of charity which had been refused from door to door. On finally leaving the village she breathed a curse upon its inhabitants. The fear of a witch's curse was strong in Scotland in those days; in fact, less than a century ago,

such powers went unquestioned, and even to-day there are many who shrink in terror from the curse of an old woman, just as there are many who would go far to obtain for their children the blessing of very old people.

That night the fear of being buried alive descended upon the inhabitants. The sand clouds were beating in waves upon the village, so that fishermen's cottages, the laborers' dwellings, and the improved grounds surrounding the fair barony of Culbin were rapidly becoming drifted over. At midnight the villagers fled. The young Laird with his wife and baby made their way out of the storm-stricken area with the rest, and one can picture the procession, for in those days there was no way of spreading information as to the kind of calamity which had befallen them.

The Laird and his wife found refuge at Earnhill, but next morning the storm had abated and the villagers returned.

The village buried

They found their cottages covered, only the roofs and chimney pots showing, but by digging down they managed to release their horses and cattle, which were then driven inland. That night the storm recommenced with double fury, and next morning not a vestige of the village was to be seen. Millions of tons of sand buried the houses, and sweeping far inland was a vast and tumultuous desert of sand. To the people of Culbin it was incredible that this vast accumulation, built up in a few hours, could have come by the ordinary course of things. It was said by many that the depths of the sea actually disgorged the

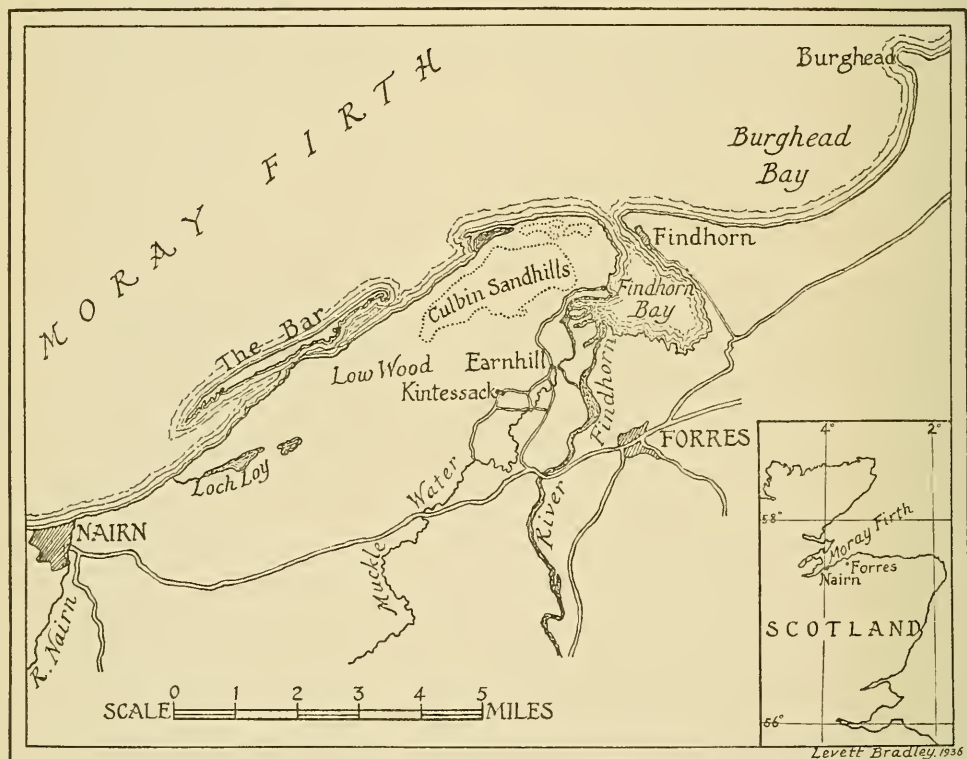
sands, and naturally all kinds of rumors and superstitions were current for many years.

The Mansion House of Culbin was, it seems, a square building standing on level ground, surrounded by its garden and grounds. The immediate lands were rich and profitable, for the area was known as the granary of Moray. Adjoining the house was a stone-built dovecote, the privilege of the Barony, but now all was irrevocably buried and lost to man's tenancy. The Kinnairds were practically ruined.

The following year the young Laird applied to the Scots Parliament for a release of land tax on the grounds that by an act of God two-thirds of his estate had been destroyed. Parliament granted the relief sought, and at the same time passed an act prohibiting the pulling of bent, juniper, and broom, the binding roots of which help to make the sandhills permanent. The act is still in force. And one

of the most interesting planting schemes is at present in progress in order to fix the dunes to prevent the sands working further inland. Marram grass is planted at short intervals, and other plants, such as *Carex arenaria*, which have strong, running roots, have at last obtained a hold on some of the more dangerous slopes. Corsican pine, Sea Buckthorn and grey alder are systematically set by the foresters, who are ever watchful for dangerous "blow outs" which might result in wholesale movement. In stormy weather it is unsafe to penetrate the area. Many lives have been lost there, and in very few instances is the body recovered.

The remainder of the story of the Kinnairds, succeeding their midnight flight from Culbin, is a sad one. Apparently the Laird and his wife lived in poverty, and both died a few years later. The little boy was taken charge of by a faithful old servant, who journeyed with



The dotted lines in the above map mark the once fertile section of Scotland which a two-day storm in 1694 buried beneath millions of tons of sand. The area has ever since re-

mained a barren waste of shifting dunes. In stormy weather it is unsafe to venture into it. Many lives have been lost there, and rarely is the body recovered.

him to Edinburgh, where she earned money for him and herself by her sewing. The boy passed into the regular Army, and it is strange that it should have been left to Ireland to recognize him. He obtained a captaincy, but died young and unmarried.

For a hundred years there was no record from the desert area. The sands sighed and the wind moaned, a region forsaken by man and utterly worthless. Then one day the roof of the old Mansion House appeared like a ghost from the shifting, drifting area. There can be no doubt about this, for workmen were at once sent to carry away the most valuable stone work, but its reincarnation was short, for in a few days it was again swallowed up in the ever-moving desert.

A living tree

Until recently there lived an old man who told how one day an apple tree was revealed from a corner of the Culbin House orchard. In response to the daylight it promptly burst into blossom which quickly matured, as though the tree were giving forth its best to propagate its kind, but the sands closed again, and it was lost.

The Culbin sands are forever shifting. The faintest eddy of wind sends sand-storms scudding across the white glitter, and a real wind entirely alters the lay of the country in a single night. Even on a still day the sands are continuously creeping; but the silence is absolute. There is no droning of insects, no song of birds, or rustle of leaves. Such timber as exists is stark and leafless. Overhead the sky is of the clearest and most intense blue, and if from the crest of the sandhills one overlooks the surrounding wold country, the fields and woodlands are endowed with a richness of coloring unrivaled elsewhere. Only on the dullest days does the sky darken overhead, and while the sands are yellow after rain, they are normally of pearly whiteness. In some lights the desert is overhung with a golden glow which seems to emanate from the sand, and I am told that when darkness gathers, the surroundings are apt to assume an unearthly purple stain, such as is sometimes seen over the Arctic snows. One of the most curious features of this land is that distance cannot be measured by eye. A companion fifty yards away may appear as a far distant figure; a slope rising almost from one's feet may appear on the remote skyline.

For centuries the port of Findhorn carried on an active export with England and the countries of continental Europe, and the interest of this extraordinary region is enhanced by its historic relics. Industries which required a high degree of skill were carried on over the area now obliterated, and when the winds lay bare the naked soil, the hoof marks of cattle and even the imprints of man himself are found as clearly impressed as on the day they were made. In the Edinburgh Museum there is an immense collection of flint arrow-heads, saws, scrapers, and knives, taken from the Culbin area. These have been picked up by casual collectors during the past fifty years, but by no means are there signs of the supply becoming exhausted. Anyone visiting the place is sure to find such relics. Numbers of articles of bronze manufacture have also been found, rings, rivets, studs, and pins, also crucibles and molds of stone. A beautiful bronze armlet of ancient Celtic pattern was recently discovered, also a small penannular brooch, one of several, was picked up by a lady, while another lady found a massive bronze finger-ring and a bronze spear-head.

Historical relics uncovered

I saw a collection of coins made by one who had visited the region for that purpose. They were extraordinarily varied, being of Roman, French, English, Scottish, and Flemish mintage. The coins range from 21 B.C. to the time of Charles II. With one exception there have been no known discoveries of treasure. At one time, a laborer working near to the area of the sands, found a bag of silver coins. They proved to be pure silver of the highest grade, and the man at once hid his find from his fellow workmen. That night he and his wife returned for the money, and from a laborer he became a farmer of some standing. His story, of course, leaked out, and some of the coins were traced and duly identified.

For all the lifelessness of the Culbin sands, the surrounding country is rich in bird and plant life. Sea birds of many kinds haunt and breed in the wild region where Findhorn joins the sea. Water plants of many varieties abound, and the Findhorn valley, so dearly loved by Charles St. John, is, from the mountains to the sea, one of the most varied and remarkably beautiful in the British Isles.

The Tragedy of the Culbin Sands

A HISTORIC CATASTROPHE IN PICTURES BY H. MORTIMER BATTEN

In 1694 a witch's curse was followed by a two-day sandstorm which completely buried the fertile Scottish barony of Culbin. The accompanying photographs show the scene of this astounding calamity as it appears today

After fleeing by night to avoid being buried alive, the villagers the next day found only the roofs of their cottages showing, and had to dig to release their imprisoned cattle. A day later not a vestige of the village remained in sight



*Stark, leafless timber:
once an apple-tree thrust
out and blossomed in the
sun; then the ever shift-
ing sands closed over it,
reclaiming their own*

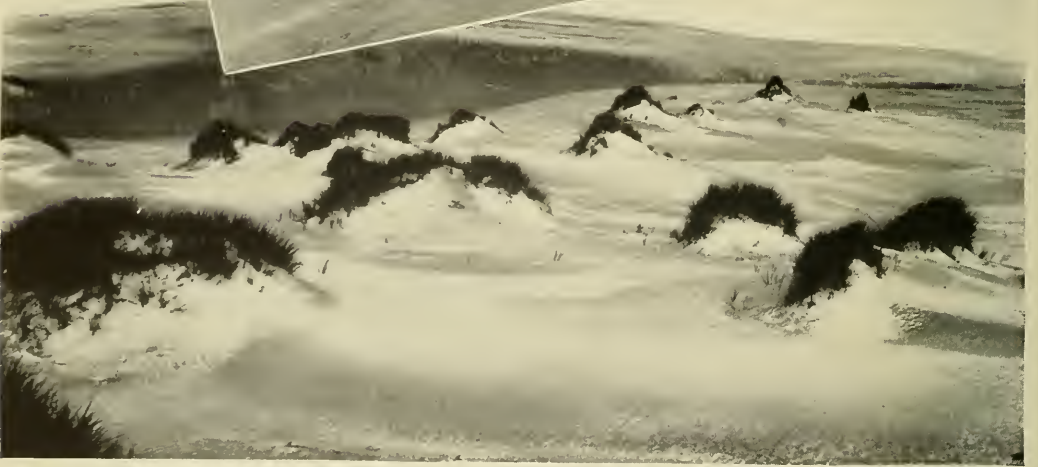




*A sudden
wind will en-
tirely alter
the landscape
overnight*



*To be caught
in a storm in
this small
Sahara is ex-
tremely dan-
gerous*



On a still day the silence is absolute. There is no droning of insects, no song of birds, or rustle of leaves; and distances are strangely deceptive

Beneath the millions of tons of sand lie plowshares abandoned in their furrows and innumerable historic relics, many of which have been found by collectors

Your Treasure-House of Jewels

A review of "The Story of the Gems" by Herbert P. Whitlock, a handbook to the position of precious stones in Nature and in human life and philosophy

By GEORGE C. VAILLANT

*Associate Curator of Mexican
Archaeology, American Museum*

MR. WHITLOCK, Curator of Minerals and Gems of the American Museum of Natural History, has had to combine in his professional work, the bleak research of a pure scientist, the joyful acquisitiveness of a collector, a professional appraiser's canny skill in evaluation, and the aesthetic sensitiveness of a connoisseur of lovely things. The joining of these varied points of view goes to make *The Story of the Gems** far more than "A Popular Handbook" as his subtitle modestly states, but rather a delightful description of the meaning of the author's Hall in the Museum, revealing as many planes of interest as the more intricately cut of his treasures possess facets.

Written for the layman

The plan of the book is broadly and logically conceived. An introduction defines gems and explains the reasons for their value. Then follows a chapter on the history and development of jewelry with emphasis on precious stones. Since the appreciation and esteem for such objects on the part of Man have caused him to direct much inventiveness and technical skill to their preparation as ornaments, Mr. Whitlock gives two fascinating chapters on the art of the lapidary and the methods of cutting precious stones.

Having laid down a basis for the appreciation of gems, the author describes the chief

groups of precious stones. The diamond well merits its two chapters, the second of which describes the most famous stones of this class. Another section covers rubies, sapphires, and emeralds. Two chapters describe semi-precious stones like topaz, tourmaline, spinel, and zircon; and chrysoberyl and opal are considered apart, as semi-precious stones that have advanced into the precious grade through intrinsic beauty and popular demand.

The quartz gems, rock crystal, amethyst, onyx, and the like, are placed in a special category since not only are these substances used as jewels but also in small objects involving artistic as well as technical skill in manufacture. Opaque gems like turquoise and lapis lazuli and a number of less known varieties have a chapter, as does deservedly jade. A chapter on unusual gem stones opens delightful possibilities for ornament, and the final chapter is devoted to such organic products as pearls, amber, coral and shell, all of which have been used as jewelry. A bibliography, a descriptive table of gems and an index complete the volume.

Handsomely illustrated

The illustrations are excellent. First and foremost is the frontispiece, a double page in colors, presenting twenty-four jewels. The play of light in these superb specimens is so faithfully reproduced by the artist that one almost seems to behold the actual gems. Judicious use is made of photographs, illustrating not only the chief treasures of the Morgan Hall but also the technique of preparing them. A lucid series of diagrams aids vastly in the understanding of the types of gem cutting.

* *The Story of the Gems*, Herbert P. Whitlock, pp. ix, 206, illustrated. Lee Furman, Inc., New York, 1936. \$3.50.

This outline gives the summary of a competently prepared handbook, but the *Story of the Gems* contains much more than the description, analysis, and appraisal implied by such a volume. Mr. Whitlock, by the use of anecdote and observation, by the heading of his chapters with astutely selected quotations, brings out constantly in his pages the relation of man to the stones he considers precious. He places as much stress on the aesthetic values of his subject as he does on the scientific, nor does he fail to lay due emphasis on the technical considerations of craftsmanship.

This approach brings out very strongly that there is far more to the appreciation of precious stones than a knowledge of their mineralogical rarity or their market value. In fact, to some of us the cost factor has become so overwhelmingly important that the intrinsic value of gems has been obscured by the ignoble one of extrinsic or commercial worth. In the Fine Arts, heavy as is the shadow cast by the astronomical prices of masterpieces, it is not yet able to dim their genuine intrinsic value to a public educated by school and museum to the appreciation of craftsmanship and aesthetics.

Yet it is rare to find an individual so absorbed in the subtle refractions achieved by the inherent beauty of his stone enhanced by the skill of the lapidary, as that same individual would be in a painting or a sonata. One might almost draw the grotesque analogy that if the public attitude to the fine arts were like its appreciation of beautiful gems, we would find on great occasions like the opening of the opera season people parading like sandwich-men placarded front and rear with masterpieces of Italian and French art, or else laboring their heaving way beneath an ancient Greek statue, vying as to whose was the heavier or more complete.

What makes gems valuable

Mr. Whitlock, however, shows very clearly why the major gem stones occupy their supreme position among jewels. Their supremacy is due to their qualities of color, hardness, transparency, and refraction of light, and not to the machinations of middle-men and super-salesmen. Fashion, of course, as in every other aspect of human life, plays its part, and to some the delicate carving of the emerald from Delhi might seem a sacrilege, since brilliance was sacrificed to graphic design. Certainly few

stones can compare with the "Star of India," the sapphire that is queen of the Morgan Hall.

Such treasures are for the few. None the less there are marvelous effects to be attained and pleasures to be derived from the use of lesser stones, which because of fragility or lack of high refraction cannot take their place with the major examples of the diamonds, sapphires, and rubies. It seems such a waste to see worn in every American community those sad little diamonds, symbolizing all our social striving, when for the same cost a rich and satisfying gem like a topaz or an opal could be obtained.

Beauty not always costly

A visit to the Morgan Gem Hall, one might almost say to Mr. Whitlock's treasure house, offers infinite possibilities for the gratification of one's most lusty craving for personal adornment. The wide variety of minerals—precious, semi-precious, and common—present possibilities for jewels which, unlike diamonds and rubies, are not, in the strictest sense of the phrase, kings' ransoms.

The late Dr. George F. Kunz called attention to the possibilities in this direction but without success in diverting public taste to a more abundant source of supply. To be sure there was some innovation in utilizing as gems stones whose value was enhanced because of their scarcity. The wearing of inexpensive but handsome stones has a further application in these days of brigandage, no less severe if more furtive than in days gone-by. It seems highly unenterprising to wear imitations of known gems when it is possible to explore fresh fields of beauty, or even to return to more primitive days when lesser gems set in relation to their settings made adequate ornament without stressing the absolute value of the stone.

Mr. Whitlock, however, gives an additional reason, Romance, why the major stones will always keep their allure. Gems are indestructible, and by changes in cut and in setting a famous stone may pass through a varied, at times bloody, history. There is a peculiar fascination in speculating as to what extremes of human cupidity governed the successive ownership of the diamond in one's ring.

A handbook is not expected to appeal to all types of interest, but the *Story of the Gems* almost reaches that goal. The problem of presentation in a handbook is very much the same as

that in preparing a Museum exhibition. The book and the hall ideally should interest as well as instruct, and both must therefore be capable of touching at some point the most extreme reaches of human social experience.

Mr. Whitlock's use of quotations to introduce each phase of his theme, is a delightful means for bringing his subject within the range of the layman. Thus before describing the famous diamonds of the world he quotes from Pliny:

"The greatest value among the objects of human property, not merely among precious stones, is due to the adamas [diamond] for a long time known only to kings and even to very few of these."

Jade through the ages

This description tallies very well with the impersonal quality of the precious stones. The chapter on jades, however, is prefaced by an observation of Confucius', "In ancient times men found the likeness of all excellent qualities in jade." The all too brief chapter on this singularly subtle carving of a stone that ranks as precious in the East and in pre-Columbian Central America, but in the Western World does not attain jewel quality, becomes invested with the pervasive charm of the East.

In the case of jade, one enters the field of what might be called subjective jewelry, since the chief pieces of carving are meant to be contemplated by the owner. In contrast to jade, diamonds and the like have an objective quality, for they are worn as much to impress others as to give the wearer direct satisfaction in their mere possession. Whereas technical consideration of workmanship enhances the brilliance of a jewel, it takes a consummate artist to create a lovely jade.

The intricate patterns used to ornament Chinese bowls, boxes, or vases, retain in outline a gracious purity of line. Goddesses, gracefully poised, show the various qualities of character possessed by the divinity. Jade is as beautiful to touch as to see, and indeed the Chinese had special pieces to finger, so greatly did they appreciate the cool contours of this precious stone. The ancient Mexicans, too, esteemed the jade above all other minerals and it is tempting to think that it is an old folk-memory of their Oriental origin.

Between the gems and the jades there is

apparent a conflict in standards of value. A flawless diamond is a work of nature dramatized by man's technical skill in revealing the innate properties of the stone. A master jade from China is precious not only because of its color but also because of the work of the sculptor who, in transforming the stone to a work of art, creates its highest value. In other words, in jade, art transcends the natural product. The early craftsmen of past civilizations were too concerned with finding means of subduing Nature and constraining it to their benefit, to be overly interested in preserving natural substances for their beauty. True they recognized some stones as more beautiful than others, but they used them as graded elements of a necklace, or in a setting, or as a substance to be carved. Natural products at first had to be subjected to human use, before they could be considered in terms of their own position in Nature. To the art historian, this primitive jewelry is more attractive than stones cut and set simply to enhance their natural properties. Yet these technically advanced methods of modern man reflect, perhaps, his lofty conception of the universe, which recognizes the limitations of man in the face of Nature.

A book for every one

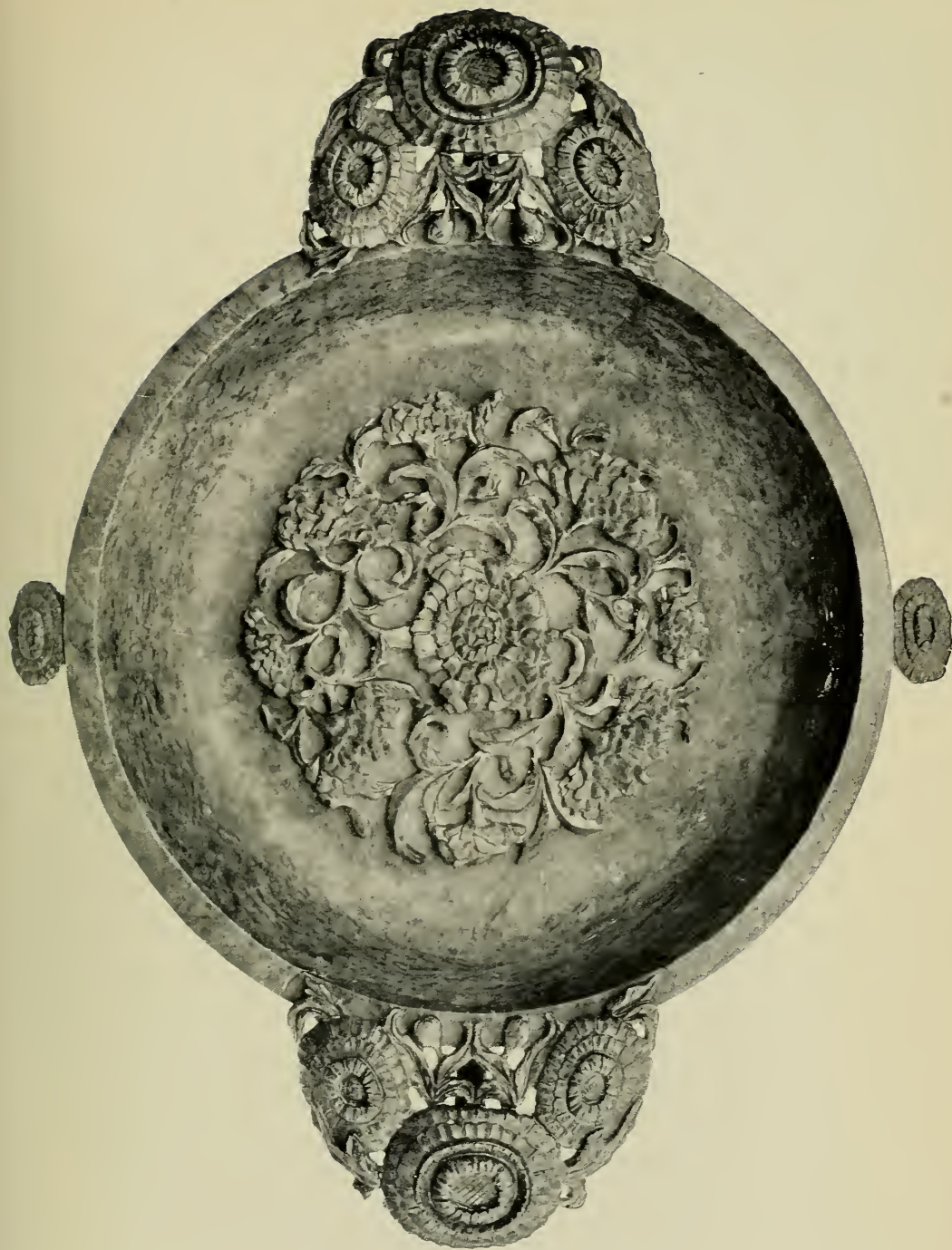
However, whether one be an aesthete, a craftsman, a mineralogist, a Marxian political economist, or better, someone with an open interest in the world around him, he will find that Mr. Whitlock has indeed told "The Story of the Gems," and has preserved a fine balance in the actual subject-matter as well as in the various aspects under which precious stones may be considered. Mr. Whitlock has, in simple language, made a complex subject intelligible, and he has set a standard worthy of emulation in all departments of the Museum, for the explanation of his Hall. It is easy to list and to explain specifically, but Mr. Whitlock has made it possible to see not only why it is of interest and advantage to have a mineral hall, but also why it is so essential to have collections displayed illustrating the physical basis of every subject. Mr. Whitlock has done us all, Museum visitor and Museum employee, a great service in his charming exposition of so fascinating a field of knowledge. He should receive our heartiest congratulations.

Your Treasure-House of Jewels

A SELECTION OF PHOTOGRAPHS FROM THE NEW BOOK,
"THE STORY OF THE GEMS," BY HERBERT P. WHITLOCK



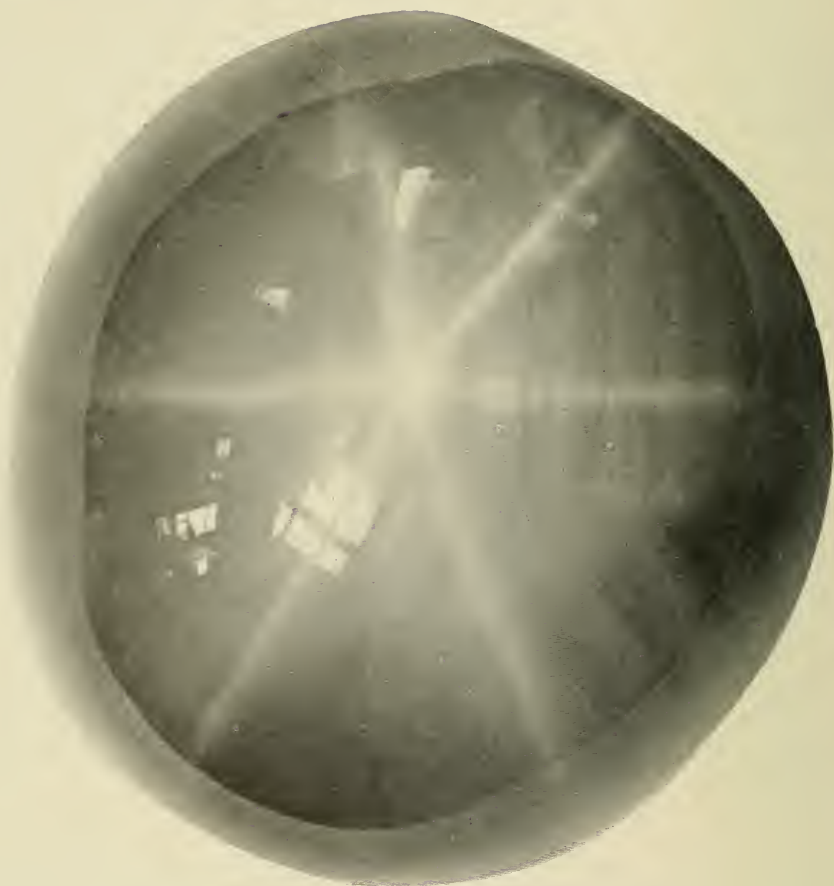
A group of gem crystals of tourmaline (rubellite) with quartz from Pala, San Diego County, California. These magnificent crystals are typical of the triangular tourmaline prism



A large bowl carved with a design of chrysanthemums from spinach green nephrite. This fine carving represents the work of the Chinese jade carvers of the last century



With its 444 perfectly proportioned facets the blue topaz shown in the photograph at the left is a marvelous expression of the art of the lapidary

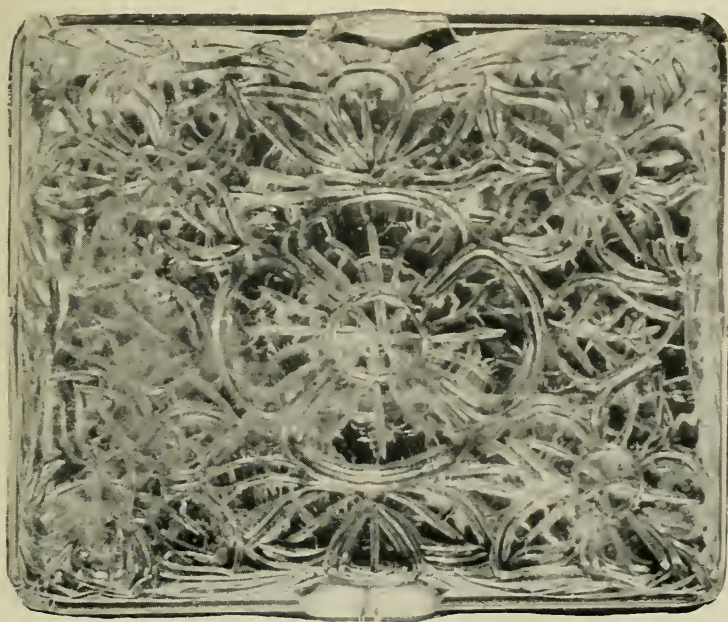


The "Star of India," the largest star sapphire gem known to exist, weighing 363 $\frac{1}{3}$ carats (Enlarged 3 times)

*A figurine representing the
"Goddess of Mercy"
carved from Tibetan tur-
quoise by a Chinese lapi-
dary*



*The Schlettler Emerald: an 87¾-carat ex-
ample of 16th century Delhi engraving.
This stone, as well as the "Star of India"
on the preceding page, is reproduced in
color in "The Story of the Gems" (Here enlarged 3 times)*



Mystery Animal

When no reasonable explanation could account for the killing of sheep and deer throughout New York State, a devotee of NATURAL HISTORY took up the trail to identify this mysterious predator

By FRED STREEVER

WOLVES, native to the Adirondacks, vanished from New York State during the last century. In my own County of Saratoga the last one of public record appears to have been killed in 1817 and a bounty of \$10.00 collected therefor, though some scattered individuals persisted in the North Woods for many years more.

Rumors of a recurrence began to float about in hunting circles about 1930 and were followed by more or less circumstantial newspaper accounts of sheep, pigs and calves being killed all over the state, and in 1933 our County Board of Supervisors replaced the antique bounty of \$10.00, at the same time declaring a night quarantine on dogs, which were suspected.

Dogs or wolves?

In the opinion of most hunters and trappers familiar through forty years of winter hunting on snow, where every trail is scrutinized and its maker identified, the stories of wolves were unbelievable. And when various pelts were turned in for the bounty we were not surprised to find one after another of them were pelts of "police dogs," some of whom showed signs of having been but lately divested of their collars.

All this talk of wolves seemed merely nonsense to me and comparable to the occasional panther stories still recounted beside the deer hunters' bivouac fires. "Where would the wolves come from?" said I, "with none south of the St. Lawrence River for over fifty years past?"

But one afternoon in mid-December, 1935, one of my friends called from the Court House where the Supervisors of Saratoga County were then in session and said they'd like me to say what I thought of an animal that had just been brought in for wolf-bounty. On the way I decided to avoid calling some good citizen a misguided nut who had killed another dog by saying that no identification short of dissection at the American Museum could be considered as positive.

Wolf!

The animal had been killed within a few hours and was not quite cold. He lay on the floor in the hall. There was quite a crowd around him as I came up the stairs, and somebody was saying, "He's a wolf all right." That riled me a little, and I had just got my mouth open when I noticed the short tail. Of course, that typical wolf brush was only a coincidence, I told myself; but the darn thing *was* higher at the withers and lower in the quarters than any dog I ever saw. I took a look at his feet (fur between the pads), and at his coat (dense fur underneath and mixed gray in color). Then they uncovered his mask: a slant eyed, sharp muzzled, curved tusked mug. And overboard went my caution.

"You can send him to Cornell or New York," said I, "for I think they'll want to see him; but for me, I'll go on record right now. It's a wolf!"

The pinch was, where *did* he come from? And if this was a wolf, there almost certainly must be others.

For me the wolf mystery thereafter remained in *status quo* until one snowy day in

January when our red fox chase with the hounds ended prematurely in the Grafton Mountains (across the Hudson River from our home). We were motoring back through the north end of the Luther Tree Plantation, an almost impenetrable thicket some 12,000 acres in extent of evergreen trees ten to twenty-five years old. In 1918 this had been the scene of many successful red fox chases both summer and winter, but the planted trees' growth had been increasing and the red foxes had about disappeared, so we had done no hunting there of late years. A new fallen snow presented its clear record of the ramblings of the night before, a maze of bunny tracks, a few grouse trails, a woods gray fox.

Strange tracks

And then we found what we were looking for but hadn't really expected to see. Strange tracks! As large as a dog's but with a more elongated footprint. Most interesting of all was the course of the trails, which as any woodsman will know determines his findings as much as does the footprint itself. A dog or even a fox would have sought the woods path for less obstructed travel but these tracks threaded the densest thickets.

During the remainder of January and early February, 1936, I tried at various times to get my older foxhounds to take the cold trails of the mysterious beasts on the Luther Plantation. Conditions were not of the best. Snow lay very deep and the hounds could do little but wallow through the thickets. Old Rambo, in his fourteenth year, seemed willing, but being a tremendously heavy hound he sunk so deep that little more than his head was above the snow, and progress was negligible. Some days we could not find a trail, nor was the weather often suitable. Late one cold February afternoon old Min, nine years old, trailed and found something or other that caused considerable and noisy excitement on her part, but before our snowshoes could get us over the three-foot snows to the scene, Min had changed her mind about it and thereafter refused the trails. We saw none of the beasts.

But we had come to the conclusion that there were five different individuals and that the range of the animals differed from day to day. They were in a different place every day but always in about the densest cover to be found. There appeared to be two females and

three males, one of which was much larger than the rest.

Finally we decided to try some of the younger and perhaps less choosy Walker hounds from my Rafinesque Kennels, near Troy. So we drove down and brought back Keene, Penny, Shotgun Joe and Red Tugwell and waited for better weather.

The Museum is consulted

Meanwhile feeling that our evidence pointed definitely towards wolves in our local hunting grounds we wrote to the American Museum of Natural History and received the following prompt reply from Dr. H. E. Anthony, Curator of Mammalogy:

AMERICAN MUSEUM OF NATURAL HISTORY,
New York,
February 28, 1936.

Dear Mr. Streever:

Your interesting letter of Feb. 27th arrives at a very opportune time. I have just today written a long letter to Mr. W. Winters, Acting District Game Protector, Saranac Lake Division, regarding the presence of canines in the Adirondacks.

For several years now the Museum has been in touch with several of the Game Protectors in that region and with certain interested individuals in the attempt to secure a series of specimens to work out the ancestry of the packs of dog-like animals which are running at large, killing game, and behaving as wolves.

There have been no wolves in the Adirondacks since the close of the last century. When these marauding canines were first reported they were said to be wolves, but when specimens were received at this Museum and at the Biological Survey in Washington, they proved to be either feral dogs or coyotes. The coyotes arrived in the Adirondacks as escaped animals and did not come into the region under their own power. The dogs, which seem to be predominating elements in the packs, are large animals, either police dogs, collies or shepherd types. Apparently the coyotes run with the dogs and the interesting point at issue is whether the two animals have crossed and there are now hybrids in the packs.

I have examined specimens which combine the characters of these two animals and the evidence seems to be best disposed of by assuming that we do have hybrids. An argument against this is the lack of adequate observations demonstrating that the two animals actually do cross. There seems to be no doubt that the escaped coyotes in the Eastern States, lacking their own kind to run with, take up with wild dogs, and this condition has been reported from several Eastern States.

I am very much interested in acquiring additional material and would be very glad indeed to have skins and skulls of any of these canines you may capture. . . .

Regarding your question as to whether a dog

may be distinguished from a wolf, my reply would be that since dogs are lineal descendants of wolves, the dividing line between large, primitive type dogs and wolves is poorly defined; that is to say, there are very few characteristics to distinguish a husky dog from a pure-blooded wolf. As one encounters the highly developed breeds of dogs, there are very obvious differences which enter into consideration and it is easy to separate the dogs from the wolves. There are certain cranial characters which make it possible to separate coyotes from wolves and from their lineal descendant, the dog, but the Adirondack animals have displayed several very confusing blends of these characters, and I am glad to learn of your interest and offer to send us material which will be valuable to get at the facts. . . .

Very sincerely yours,
(Signed) H. E. ANTHONY,
Curator of Mammalogy.

Something more than dogs

Closely following Doctor Anthony's response came a letter from a kinsman of mine who is District Game Protector of Saranac Lake Division in the upper Adirondacks. Ray Burmaster always speaks his mind, and on the matter of whether these disturbers were feral dogs or not Ray had few or no doubts. His letter follows:

State of New York,
Conservation Department,
Saranac Lake, N. Y.

Dear Fred:

. . . I am not surprised . . . that you are finding some of these so-called mystery animals down there. . . .

The way it started up here is as follows: For a good many years I have received information from the natives living in the Town of Belmont in the vicinity of the headwaters of Trout River about wolves being up in there. Every once in a while some guide would come in and tell me about hearing them howl. Also I was continually receiving complaints about dogs running there and chasing the deer out of the country. On several different occasions I sent Game Protectors in there and they found where deer had been killed and eaten up. They found tracks of what they supposed to be dogs; but were never successful in catching sight of any of them.

A few years ago, an old hunter and trapper who lives on a farm which borders the forest in a locality which is known as the 'Caughlin School section' in the Town of Belmont, claimed he saw seven wolves cross his farm, traveling in a southerly direction in single file, and going towards the woods. He claimed there was a very large animal at the head. This man has hunted and trapped wolves in Canada and he impressed me as being reliable when I talked with him.

Robert Kimpton, another old guide and hunter who resides on the Salmon River about four or

five miles south of Malone, attempted to raise sheep. He owns quite a lot of land at the head of Trout River . . . and he pastured his sheep on this land. However, he had so many sheep killed that he was obliged to give up the venture. Of course, we all laid it to dogs; but Kimpton was satisfied that there was something more in that section than dogs.

Wildest and shyest creatures

Ray Burmaster went on to tell how two animals were caught alive and another one was shot. But disagreement resulted as to the true identity of the predators. His letter continues:

The male looked to me exactly wolf color, and the female was redder than any red fox I had ever seen.

I then detailed some of the Game Protectors to go into a section where we know these animals were to try and snare them. I spent some time with them myself, and I do not hesitate to say that these animals are the wildest and shyest things I have ever seen or heard of. We would find where they were disturbing beaver houses. We would find fresh signs and set a few snares in that vicinity and they would never return there again. We would hunt for several days all thru that country until we found fresh signs of them in some other locality. We would make a few sets, and that would be the last we would see of them in that section. We took a sheep up in the woods and killed it, and in due time foxes, skunk, and other animals came and ate on the carcass, but never one of these animals came near it. Foxes would follow our snowshoe trail but we never saw where any of these animals came nearer than 20 or 30 feet from the trail. If they came down off the mountain, when they got near the snowshoe trail, they turned and went back, and that would be the last we would see of them in that immediate vicinity.

The Game Protectors caught a glimpse of two they happened to surprise upon a ledge on the side of the mountain, where they were feeding on a deer. The signs there showed this pair had been feeding for a considerable length of time, but after the Protectors frightened them, they did not return there again that winter.

In February, 1934, the Protectors were successful in capturing one of these animals in a snare. . . . This was examined by the Biological Survey of Washington, and after some length of time they told me that the easiest way to settle the controversy was to call them dogs. Doctor Anthony examined it and was not satisfied to agree with their decision.

That spring Robert Kimpton shot another animal that was one of three he came on to trying to get a beaver out of one of his traps. I sent that animal on to Washington and they reported that it was a dog.

Later on that spring several of these animals were killed owing to the Supervisors of Franklin

County giving a bounty of fifteen dollars each. Several men went in and trapped them. John Garland, a very good trapper, caught several puppies and Captain Broadfield kept three of them alive. . . . One died and he still has the other two. . . . No one can get near them but him. I am enclosing a snapshot of Captain Broadfield with one of these animals. He has finally been successful in breeding them and now has five puppies which are about three weeks old. In talking with him the other day, I am quite satisfied he has changed his mind somewhat as to the identity of these animals and that he has come to the conclusion that we should not overlook their importance as predators.

It would seem to me that if these animals are wild dogs that we would find different color phases among them. No one ever has found one yet any other color except wolf-gray or red or rousous. . . .

Very truly yours,
(Signed) RAY L. BURMASTER,
District Game Protector,
Saranac Lake Division.

We will pass over the discouraging days of the next six weeks spent in getting hounds to follow the cold trails of unaccustomed quarry.

Elusive shadows of the thicket

Hounds are very interesting and intelligent sporting dogs but none the less aggravating at times. Besides this part has been told at some length in two hunting magazines.* To summarize many winter days followed, some rewarded with chases and some without, during which the gray shadows of the thicket earned a record of crafty elusiveness.

Then, when winter was passing, there came a wet and belated fall of snow on the evening of March 8th. The story of the next day's experience is best given by a letter I wrote the next night before tumbling into bed. If you, Reader, have followed my report so far with some of the interest of the huntsman you may consider it directed to yourself instead of W. H. Foster of Boston to whom it was addressed.

. . . It is now March 9th and tonight my every stitch is draped round the big fireplace. Wet slush is the coldest thing I know of and it has been falling on my back off the Luther pines about all day. The snow we had been waiting for started last night but by morning it was more rain than snow.

I woke at the first light and was mighty pleased, as always, to see the new snow. . . . I put Ruffian and Shotgun Joe and Tug in the truck. Old Fritz clambered into the top deck and refused to budge so I left him there.

*National Sportsman, July, 1936.
Outdoor Life, August, 1936.

It was a dark, lowery morning and raining plenty over across the Lake. . . . Some slush still hung to the pines so that everything was adrip. But we found a wolf track and put Ruffian on where it left the roadway.

In twenty minutes Ruff was back and ready to get in the truck. It appeared *he* was *not* a wolf dog. This was a great disappointment. Ruff is our standby on bad going. But I took Joe on leash and cut a circle around the deep gully across which the track led off. It was tough going. Quite a lot of ice on the snow and it was rotten enough to break under my shoes and with Joe's chain in one hand and my gun in the other there was no chance to save myself. Besides, the pines were planted only six feet apart and, of course, their 15-year-old branches are now interlaced.

After falling headlong several times, getting the gun barrel full of snow and plenty up my sleeves and down my neck I decided to cut across the gully. That was a mistake. In the gloom I lost bearings and first I knew I was back into the highway and hadn't enclosed the wolf trail at all. I put Joe into the truck and went up to where my companion Verne was on watch. Verne suggested my taking a little path he knew of which left the highway a mile north and this I did. But when I opened the truck door Ruff jumped out and knocked me over and Tug and Joe took advantage with the result that I had only Joe on leash and Ruff and Tug gave me the laugh as they ran off in the opposite direction from where I wanted them.

Wolf scent

But, after I'd gone a couple miles over the wood path, they thought better of the escapade, and following on, overtook me out in the densest part where Tug squealed as he got a little wolf scent. Joe took the trail too and I unsnapped his leash. Ruff didn't want any wolves. And after I'd followed along another mile or two he left me in disgust and headed back toward the car.

Trailing was poor enough but we made progress. I soon lost my bearings and when the going freshened up had no idea which way we were heading. It had continued to rain. . . . My snowshoes weighed ten pounds apiece and the lacings were a mere bag. . . .

It was two hours before I found my way out of the tangle and I was a mess by that time. Even my leather hat was soaked through. My joints were stiff.

The chase had led right back at Verne. Ruff was there and had joined in, and they made the thickets ring. Chub Halloran had arrived and he and Verne had seen the wolf *five* times while he was being chivvied around the country by the three hounds. Sometimes the big gray fellow was only a few rods ahead. At others a short turn would gain him a hundred yards' lead. . . .

Shortly after I got back to the road, thoroughly wet and miserable, the chase made a bad loss. Up to that time it had been just one furious, continuous drive. The rain was just coming in straight lines and the loss looked pretty bad, though the

hounds were still hard at work on both sides the road.

I went to the truck and found a dry piece of newspaper to wipe my glasses as I had been too blind for an hour to shoot if the chance had come. I got a dry pair of gloves, caught Joe and Tug and gave them a biscuit apiece. Then Ruff came but he went on back up north searching. After resting a minute or so the heaviest rain seemed over. So, though it was late, I took the young hounds out again.

Fritz was fresh but he is pretty old and crippled. Tug was used up. He is small anyhow and had been leading through the slush breaking path. It got later and later and the only excuse we had for sticking at it was that it would soon be dark anyhow and that somewhere in that forest there was a tired wolf. We wanted him.

The Mystery Animal is run down

Suddenly Fritz let out a single squeal away up north on the sand knoll. Joe went to him, Ruff followed and they began trailing again. Another half hour and we were again lined up while the chase faded into the southwest and away from us. It had been still for fifteen minutes when I heard a few more hoots far to the west and north. It seemed about over for the day but, through force of habit, we stuck to our appointed watches. And then a gun cracked up the road.

I'd been waiting for *that* all day. Then two more shots. Then another and five minutes another. . . . On the chance that the shooting had been done at a wolf other than the one the hounds were after I drove up the road with Tug and found Verne peering into the thickets. The hounds were still over north of us. A wolf had come out to the edge of the thicket and though Verne was waiting with cocked gun, he turned on his own trail and was almost out of sight before Verne could shoot. The charge of chilled two's cut hair and bled the wolf badly.

Verne shot twice after that but the brush was very dense. Chub was down in the gully on the trail. . . . The hounds came through while Verne and I stood there, and just before they got to Chub on the blood trail we heard his rifle crack again. This time he connected. But it was still some time before he could drag the carcass up the bank and through the dense pines. Daylight was gone when he got out into the highway again. We had to call to give him his bearings.

The hounds did not shake the carcass as they would have a fox. We set the camera up in the effort to get a picture. I gave it a minute exposure but the photos are probably not much good. . . .

I could not see any resemblance to the dog intermixture supposed to be characteristic of these animals, but expect to ship the carcass down to H. E. Anthony of the American Museum, New York City, for a close examination after Verne has claimed his bounty money.

You must excuse my enthusiasm. The hound music is always very stimulating and I now realize that I

had hardly expected we could really drive one of these critters ahead of the hounds long enough to kill him. We all got a big kick out of the race and its successful outcome. . . .

I think there are at least four more of these brutes down in the Luther Trees Plantation. My own opinion is that they are wolves or coyotes and that there is no interbreeding. More than that I do not believe that these things run with the cur dogs, either wild or tame dogs. Of course, there are plenty of roaming dogs and with the actual presence of wolves or coyotes and the increased killing of sheep as a result of their presence we are bound to hear some weird stories.

The bounty, too, which hearsay has it, is \$5.00 for "wild dogs" and \$15.00 for "wolves," will not tend to diminish the sensational stories.

This big he "wolf" hasn't *any* dog characteristics that I can see, a chubby tail, a particularly good set of teeth, a good dense coat of underfur and most of all his peculiar odor, totally unlike any dog odor. Much more like a fox but not *quite* as musky.

I hope to get some more of the younger hounds started on them. Our older ones are too well broken to enjoy transgressing. Ruff is a wonderful fox dog, but he would not take the cold trail this morning.

Another gray predator

Following the chase and kill of March 9th came other chases. On April 8th a very large animal was cold trailed and routed and viewed by myself three times as Old Fritz and Min and Ruffian noisily chivvied him about and through the dense thickets in the Luther Plantation. The next morning our enthusiasm got us out before dawn with eight hounds. After a chase which lasted perhaps eleven hours, sunset found us with another gray predator—an old female this time. The tactics employed were largely "doubling," that is, a turning back on the trail and a wide leap aside.

This summer there are still at large several of the animals in or about the Luther Plantation. If our reading of last winter's snow pages are correct there are one large and old, one small and younger male and one young female left to harry the farmer's sheep and poultry and to take a larger toll of the fawns, bunnies and perhaps of the grouse of the wilderness.

Apparently the distribution is wide.

I have no patience with the wild dog or dog-wolf theories which have obtained credence in some quarters. There is an animal that I saw occasionally in the Wyoming Country while hunting elk during the falls of 1924-25-26. We noticed their plentiful dog-like tracks in the snow and among the dense

fir thickets of Andersen Creek, of the Grey Bull and of the upper Wind River. One day, in such surroundings, I caught an instant's clear, close view of a large, darkly grizzled shape. A few days later, far in the valley below, a silhouette paused at the edge of the thicket and my long, but fortunate, rifle shot laid low a light gray animal, free from any rufous tints, which I should have called a timber wolf. But Brian Sullivan (of Ned Frost's outfit, Cody, Wyoming) identified it as a timber coyote. A bit farther east and northward they call them "brush wolves."

True enough there are plenty of wild dogs in New York State and there may be crosses of them but there are also, to my personal satisfaction at least, a plenty of Simon pure "brush wolves" or "timber coyotes," not as vocal or as small as their Mexican brethren, not as fiercely dangerous as the lobo or true timber wolf.

The verdict

But you will want to know what Dr. H. E. Anthony thought of the two complete carcasses and the extra skull I sent him. Here is his latest letter but hope *not* the last (he has promised to come up to my hermit's cabin and join myself and hounds in next winter's observation of the development of the coyote situation):

AMERICAN MUSEUM OF NATURAL HISTORY,
March 23, 1936.

Dear Mr. Streever:

I received your letter of March 20th this morning and wish to thank you for donating the skin to the Museum. I had completed my examination of the skin and it was about to be returned to you, but the complete specimen constitutes a valuable and interesting record, and I am very glad to have the privilege of retaining it.

A careful examination of the skin and skull of this animal compared with coyote, wolf and dog confirms the early impression I had that your animal is a coyote. The skull is practically indistinguishable from the skulls of coyotes taken in the Western States, and although the skin, as I mentioned in my earlier letter, is not as brightly

marked as most skins of coyotes, the final conclusion must be that your animal was either brought into New York by human agency or is a descendant of such an imported coyote.

Coyotes are sometimes called prairie wolves, and to the lay public there are not very many striking characters of distinction which stand in the way of considering the coyote as simply a diminutive wolf. However, there are rather fundamental differences between wolves and coyotes and the two lines of descent parted so long ago that today they are not likely to interbreed, if indeed they are genetically capable of doing so.

Boiled down, this means that we do not have wolves in New York State if by wolves one means true wolves or timber wolves. The prairie wolves or coyotes which have been brought into the State by man himself are running at liberty here and thus by a stretch of the imagination one might speak of wolf-packs in New York, although this would not be strictly true. The timber wolf, the old-time wolf of the early settlers, had a head twice as massive as the heads of these coyotes, and the body of the animal would weigh several times as much.

The skull of the animal which you cut off of the hanging carcass appears to belong to the same type of animal as the one your dogs ran down and I have considered it to be a coyote. I am glad to learn by your last letter that the skin of this animal was gray in color.

Have you or any of your friends heard these animals howl?

Assuring you of my appreciation of your cooperation, I remain,

Very sincerely yours,
(Signed) H. E. ANTHONY,
Curator.

Undesirable aliens

And how did they get here? Specific instances of coyote and of wolf pups bought in the west by tourists, of gasoline station menageries, and of domesticated coyotes or even wolves are not hard to find nor are such confined to any one county in the State. As in the case of most undesirable aliens among us, smuggling and subterfuge has doubtless been practiced.

The problem is no longer when or how they got here but what or even whether we can do anything about it.



Mystery Animal

The last wolf of public record in New York State was killed in 1817, but when depredations among sheep and other

domestic animals were reported in various parts of the state the cry of "Wolf!" went up. Was it justified?

Drawing of Mystery Animal in action by MORGAN STINEMETZ





Strange tracks which strengthened the belief that there were wolves at large in New York State: prints as large as a dog's but more elongated, which threaded the densest thickets

Fred Streever Photos

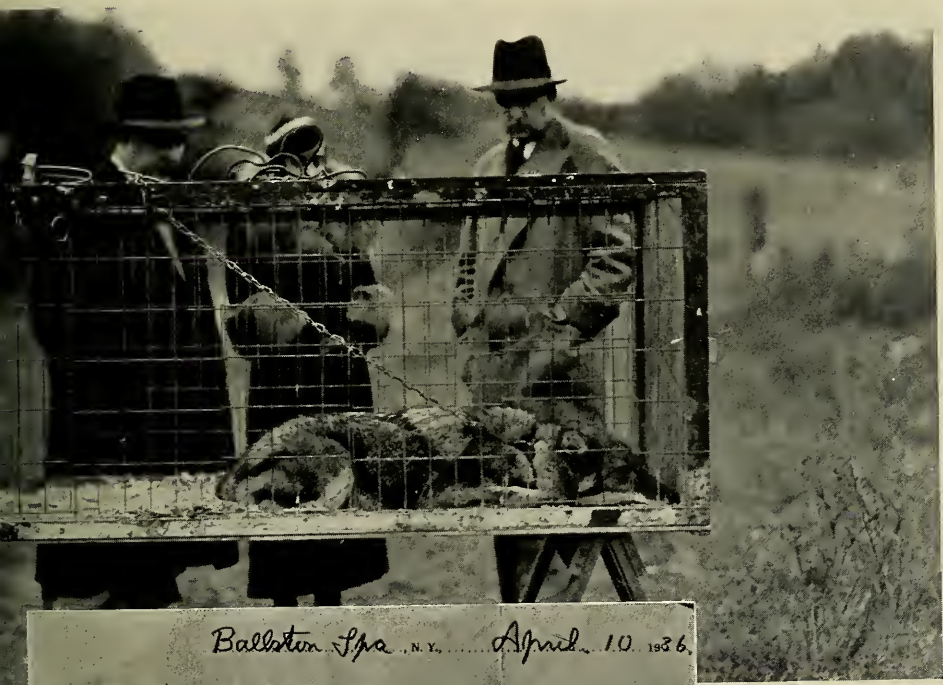
(Right) The Mystery Animal brought to earth: Fred Streever (right) and his hunting partner George Cull, with the hounds which ran the culprit down



(Left) One of the gray predators, which local hunters considered a wolf: an animal trapped by Claude L. Eddy and mounted by E. P. Hotaling

Fred Streever from E. P. Hotaling

Shotgun Joe, who liked to chase "wolves." The hounds did not shake the carcass as they would have a fox



Courtesy
New York
Conservation
Department

Ballston Spa, N. Y., April 10, 1936.

County of Saratoga

TO F. L. Streever DR.

IMPORTANT—This bill must be itemized. Fill in affidavit and swear to claim. See affidavit form on back hereof. Write your name and address plainly at the top of this sheet. Claims MUST be approved by the County Department before the service or material. All bills are paid twice each month and MUST be in the hands of the Auditor not later than the 15th and 25th of each month.

Apr. 10 1 Female wolf Bounty, \$10.00

F. L. Streever, having this 10th day of April brought to me, as Justice of the Peace of Town of Ballston Spa, County of Saratoga, one female wolf for bounty of Saratoga Co. Wm. H. Formley Justice of the Peace County of Saratoga

An animal which the Kimpton Brothers brought back alive. Men with experience in trapping wolves and coyotes in the West and Canada all pronounced this animal a young timber wolf

(Left) The animal which Fred Streever brought in to clear up the mystery was a wolf in the eyes of the law; but the Museum's verdict is that these alien animals are coyotes or "prairie wolves"

The Glamour of the Giant's Causeway

A visit to one of the most curious rock formations in the world, whose scientific explanation is less generally known but no less simple than its legendary origin

By HARRIET GEITHMANN

IT IS hard to explain why certain far corners of our precious planet capture our imagination even in childhood. The Giant's Causeway on the northeastern coast of the Emerald Isle captured mine when I was scarcely bigger than a grasshopper. Doubtless the word "giant" was the first alluring feature.

Finally when I reached Glasgow, Scotland, that same childhood whimsy took me by the hand and down the River Clyde we sailed for Londonderry and the Giant's Causeway. On that outstanding occasion it seems to me that every Scottish and Irish old-timer whom we met was exactly 70 years old and had served the public for exactly 30 years. As we glided past Kilpatrick 70-year-old Captain MacCullum who had sailed between Scotland and Ireland for 30 years, flashed us a whimsical smile with this remark:

"This is the very spot where St. Patrick, the canny Scot, was born and stepped across the Clyde after which he continued on to Ireland and chased out all the snakes and became a saint."

Off for the land of "giants"

The following morning as we churned across the River Foyle under the eyes of the Ballynagari Lighthouse and entered the harbor of Londonderry, that ancient walled-in city of Ulster, famous for its linen shirts and collars, we listened to a native daughter, Maggie O'Connell, crooning softly at the rail: "O Ireland, I'm sufferin' for you," and later, "If you are Irish come into the parlor, there's a welcome there for you."

In all directions our eyes rested on enchanting woodland glades starred with chestnut and hawthorne trees in full bloom and showers of scarlet rhododendrons. On leaving Londonderry, a rocky road flanked by snowy hawthorne hedges and ash trees shaking hands overhead, led us not to Dublin but to Portrush, the very gateway to the Causeway country, a country of fairies and giants forever in the offing. All along the way we enjoyed glimpses of country life in Ulster, clean, spotless farmhouses with whitewashed walls and thatched roofs, shelter for man and beastie. To our left glistened the blue surfaces of the Atlantic with the white surf pounding at the base of the limestone cliffs. To our right were green fields of oats starred with scarlet poppies and pastures where cows, crows and goats were content. Fragrant with the romance of the sea was each and every one of the seacoast villages through which we sped on our way. There were Ballykelly and Limavady, Bellalarna and Umbro, Castlerock and Colrairie, each an Irish gem of color and simplicity. Yellow laburnums and purple lilacs, primroses, bluebells and poppies made Eglinton a poem of color. Boys and their dogs drove their cows and goats along the narrow winding streets while girls, handy with brooms, waited in the doorways ready for all emergencies. Shaggy donkeys were traveling hither and yon hauling fathers and mothers and their youngsters homeward in crude carts.

An atmosphere of Irish myths

At Portrush, a 70-year old-timer, Don Martin assured us that he had driven a taxi for 30 years and if we would but deign to

ride with him he would land us at the Causeway before we had left Portrush. Don was thinking in terms of American shekels hard and fast, almost too fast. We were loath to travel with such incredible speed to make our first call on the legendary bridge of the giants, therefore we cast our lot with Joe Fisher, another 70-year old-timer, who admitted that he had been a jarvey around the hills of Portrush for 30 years. Climbing into his raggety-taggety Irish jaunting-car we jogged along easily after Billy, the bay. Cracking his whip over Billy's indifferent ears, Joe introduced us to the Skeery Isles, the haven of wild ducks and rabbits, the gleaming limestone cliffs and a promontory called the Giant's Head. Without half trying we saw the giant's huge freckled nose sniffing the salty tang of the sea, his daring goatee, his noble forehead and his green cap of moss with a button on top. The Lady's Wishing Arch reminded us that we were in the atmosphere of Irish myths. High upon a velvet bluff stood the crumbling ruins of Dunluce Castle erected ages ago with an eagle eye to a quick getaway.

The Giant's this and that

Finally, Billy, the bay, dropped us on top of a knoll in the shadow of a cluster of bleak hotels. With guides galloping at our heels offering to introduce us to the Causeway by boat, we left them and the ice cream cones far behind as we jogged down a steep and rocky trail and serenely approached the geological wonder on foot. Behind a picket fence, we found 3 spits or tongues of pillared stones slanting out into the sea, the Little Causeway, the Middle or Honeycomb and the Grand Causeway, all of them in the County Antrim on the northeastern coast of the Sharnock Isle. The very moment we dropped our sixpence and went through the turnstile another 70-year old-timer, Jimmie, pounced down upon us and like babes among the stones, we gathered that if we refused Jimmie's services, the result of 30 years of experience in guiding folk over those columns, we would be lost indeed. Therefore with Jimmie limping on ahead we trekked all over the Causeway and breathed deeply of an atmosphere of giants.

Every time we turned around we heard of the giant's this and the giant's that. Jimmie

introduced us to the Giant's Horseshoe, the Giant's Honeycomb, the Giant's Cannon, the Chimney Pots, and the Keystone of the Causeway, which is the most perfect octagonal pillar; the Giant's Loom, 30 feet high; the Giant's Gateway and the Bishop's Mitre, five-sided and even all around, the most perfect pillar in the entire Causeway. The Lady's Fan, a perfect combination of five pentagons surrounded by a heptagon, all embroidered with moss, was a gem. Then we found the Giant's Organ Pipes and best of all the Giant's Wishing Chair, a regular Morris chair of stone with arms and back towards the sea. Here at Jimmie's firm command we rested in the quiet air of the giants and solemnly registered three wishes all of which will come true eventually if not sooner IF we do not tell them to anyone on earth.

Thus were we personally introduced to the most distinctive members of the great Causeway family of 40,000 polygonal stones or columns, most of which we found standing perpendicularly with but a few of them lying horizontally. Most of them were arranged in sections varying from a few inches to several feet in height, all of which are fitted together like a great mosaic, convex ends and concave ends, 15 to 20 inches in diameter. Many-sided were they, triangular, pentagonal, hexagonal, heptagonal, octagonal and the largest of all was a nine-sided column. There were but two of these large columns and both of them were embroidered with tawny lichens. Jimmie pointed out that the wide sides invariably face one another and the narrow sides do likewise. We even found a diamond-shaped pillar. With the exception of the black pillars which indicated the high-water mark, the stones were silver-gray in tone, embroidered here and there with tawny lichens and tiny pink flowers. The Causeway reflects the changing moods of the Irish sky from dawn to dusk.

How it was created

Forgetting for the moment myths and metaphors, one pauses to ask how this spectacular formation was created. Geologically the Giant's Causeway is one of the most notable examples of prismatic basaltic columns on the face of this planet. It extends like a natural pier some 300 yards along the coast of County Antrim in northern Ireland and out

some 500 feet into the North Channel, and then reappears at Fingal's Cave on the Island of Staffa on the West Coast of Scotland.

Other fine examples of this same kind of formation are those scenic cliffs called the Palisades on the Hudson, the Obsidian Cliff in Yellowstone National Park, those along the Connecticut River, in the traps on the shores of Lake Superior and those walls along the majestic Columbia and the Deschutes River in Oregon.

As to the volcanic origin of this extraordinary columnar structure, authorities generally agree that during the Tertiary Period a great outpouring of basalt took place in this locality. As the molten lava was going through the process of cooling and contracting, it apparently broke up into regular sections of polygons in much the same manner as mud flats or even quantities of starch will dry and crack up into polygonal shapes when left to the mercy of the sun. It has been pointed out that the composition of the lava must have been unusually uniform. At the Giant's Causeway these polygons are strikingly regular and range from a few inches to several feet in diameter. While most of them are hexagonal, some of the columns are four, five and seven sided due to the fact that the centers of contraction were not always equally spaced. Both at the Giant's Causeway and Fingal's Cave the prismatic jointing of these basaltic columns has been developed to a high degree.

Like cordwood on end

Another principle seemingly true of this particular type of prismatic structure is that it invariably develops at right angles to the plane of cooling and resembles so much cordwood all stacked on end. This horizontal plane of cooling was not a surface layer of air but a thin formation of overlying rock which has since been removed by the agents of erosion.

The entire area of both the Counties of Antrim and Londonderry are known as the red zone, owing to the basaltic red iron ores which overlie them. These ores are the direct result of the underlying sheets of basalt, some 300 to 500 feet thick, the same igneous material out of which the Giant's Causeway was formed.

"Beyond yon point," smiled Jimmie serenely, "lies the Spanish Bay where the giants de-

stroyed the Spanish Armada all because the soldiers dared to fire on these same limestone cliffs thinking they were fortresses. And on that rocky promontory to your left you can see the Giant's own grandmother forever struggling up hill with a sack of chicken feed on her poor old back. However long you watch, she never seems to make the summit."

In another romantic niche among the stones we found the Giant's wishing-well and Jimmie's own white-haired buxom frau biding her time on the brink, ready for thirsty and superstitious mortals with pitchers and cups. There we wished again as we slaked our thirst from the bubbling spring water and paid another sixpence as we wished. When all of these wishes come true, but that's another story.

At the crown of the bluff, waited Billy, the bay, and Joe Fisher a-top his raggedy-taggety Irish jaunting-car.

"Did Billy have a good rest?" we inquired as we climbed in.

"Aye," laughed Joe, "he had a nap and a feed of corn."

More legend

Bouncing back to Portrush we learned more about the mythical Causeway. "Long before the memory of man," mused Joe, as he flicked his whip over Billy's ears, "the Giant's Causeway was created. 'Tis certain no engineer built it. Around the hills of Portrush we believe it was built by an Irish giant who had a quarrel to settle with a Scotch giant who lived across St. Patrick's Channel at Fingal's Cave. He even challenged the Scottish giant to come over and fight it out and the brawny Scot said he would be glad to accommodate his enemy IF he would build a bridge, which he did. The same formation is to be seen out at Fingal's Cave on the shores of the Staffa Islands. No one seems to know exactly who won the famous bout but we Irish have our own opinion and then there's the Causeway, this end of the Giant's bridge."

With this long speech Joe looked out over the Channel at Fingal's Cave and cracked his whip disdainfully.

Joe's legend sounded almost plausible to our American ears. We found it easy to listen to these 70-year old-timers with their 30-year-old experience along the romantic shores of the Shamrock Isle, especially in the atmosphere of the fairies and giants of the Causeway country.



De Cou from Ewing Gallosway

The Giant's Causeway

A mosaic of forty thousand polygonal columns of stone comprise the Giant's Causeway, on the northeast coast of Ireland. Except where the tide reaches them, the columns are silver-gray in color, embroidered here and there with tawny lichens and tiny pink flowers.

Legend has it that the Causeway was built by an Irish Giant who challenged a Scottish

Giant living across the channel at Fingal's Cave, daring him to come over and settle a quarrel. The Scot is supposed to have replied that he would accommodate his enemy if he would build a bridge across—which he did. If you don't believe the story you can find the other end of the bridge at Fingal's Cave. No record revealed the quarrel's outcome



The Giant's Causeway extends like a natural pier for some 300 yards along the coast and out about 500 feet into the North Channel. It is one of the most remarkable examples of

prismatic basalt columns in the world. It was formed when a great outpouring of molten rock cooled and cracked into polygonal sections, much as mud does when it dries

The columns are strikingly regular and range from a few inches in diameter to several feet



Erwing Gallozway



De Cou from Ewing Gallows





E. M. Newman from Publishers Photo Service

It is no wonder that the heavy blocks of stone which in places appear to have been put in place by human hands are attributed in legend to a giant



(Right) A honey comb in stone: a level space on the Giant's Causeway. The majority of the columns are six-sided, but as many as nine sides are sometimes to be seen

Ewing Gallowsay



An unusual view showing the size of the sections that make up this volcanic wonder. The sides are not equal, but it is to be noted that the figure is symmetrical, opposite edges being similar (Photo: Mrs. Branson de Cou)

Science in the Field and in the Laboratory

Total Eclipse Photographed—Trophies from Indo-China —Swordfishing—Fall Lectures.

Astronomer in Siberia: A Total Eclipse, Huge Craters

For a brief period this summer, the sun ceased to shine on a part of what once was the Russian Empire, and astronomers who had presaged the event eagerly looked forward to the discovery of additional information regarding that body.

Dr. Clyde Fisher, head of the Hayden Planetarium, had two objectives in mind when he sailed last May for the Soviet Union. His expedition called for motion pictures of a total eclipse, and an investigation into the enormous Siberian craters that had been gouged out of marshy ground in the meteoric deluge of June 30, 1908.

A recent report from Doctor Fisher states that in conjunction with Harvard's expedition under Dr. Donald Menzel, he was able to record photographically this solar phenomenon whose path of totality extended from the Mediterranean Sea to Greece and thence clear across Siberia and northern Japan to the Pacific Ocean. Camera conditions were perfect but he has not yet seen the developed film.

Doctor Fisher's efforts to attain his second objective were crowned with no such success. Only a few hundred miles from Ak-bouliak, in Kazakhstan, where the eclipse pictures were taken, lies the scene of one of the most socially calamitous, but scientifically important meteor showers in history.

Almost exactly 28 years before the occurrence of the total eclipse, 200 shellhole-like craters appeared as if by magic in about 2 miles of swampy forest. They were left in the wake of a meteoric torrent that felled and unbranched trees, shattered peasant huts, slew whole herds of reindeer, and was recorded on a seismograph at Irkutsk 900 km. away. Only one expedition, under the Russian professor, Kulik, has visited these giant craters, some of which stretch 50 yards in diameter. So it was but natural that Doctor Fisher was anxious to extend his expedition with a view to contributing further information. He was disappointed to

learn, however, that an excursion to the craters was impracticable at that time.

In a late communication to Mr. Wayne Faunce, Vice-director of the American Museum, Doctor Fisher was able to give more heartening news. "The whole thing," he says, "may be affected—I am not quite sure—by the fact that the Soviet Government has planned, and financed, they say, an expedition to these craters next year. The permanent secretary of the Academy, who is one of the finest two or three Russians I have met, told me that if I wished to accompany this expedition, I would be welcomed.

"After being disappointed about the Siberian craters, I concluded to try to visit those on the Island of Saaremaa (Oesel), Estonia. Estonia is straight west of Leningrad, and therefore is directly on my way back to Stockholm. I shall try to gather material about these craters for an article in NATURAL HISTORY. I feel sure they have never been visited by an American—probably by very few scientists."

D. R. B.

Fleischman-Clark Indo-China Expedition

Deep in the jungles of Indo-China Dr. James L. Clark lolled beside his expedition camp fire and listened to squadrons of elephants trumpeting in the spring night, as they trampled nearby grassy patches.

Accompanied by Major Fleischman, he had taken leave from his post as head of the department of Arts and Preparations last February to become co-leader of an expedition predicated to the collecting of museum specimens ranging from mammals like the banting, a big wild ox that resembles a handsome Jersey bull, to frogs and lizards.

Establishing headquarters at Saigon in March, the expedition headed north for a 300-mile trip into the jungle, ably guided by M. Defosse and his son Louis.

Automobiles transported the expedition to a little place called Dong-Me, where a camp and field laboratory were set up. "Two weeks spent here resulted in a fine collection of the vividly colored

local birds, snakes, bats, and interesting lizards of several varieties," reports Doctor Clark.

Often plodding 12 to 15 miles a day under a scorching sun, excursions set out on foot from Dong-Me in pursuit of the banting. Several specimens were secured, including a fine bull and cow. Of these, the complete skeleton of the bull, and both skins were preserved. Fresh tiger trails were seen almost daily, and elephants, plying in all directions, left their broad, smooth trails. Integral specimens of the wild pig were also taken here.

The expedition then moved southward about 200 miles to the Lagna River where, on the broad grassy plains of this great game section, specimens of the wild water-buffalo were hunted and secured, as well as the Saladang, the hog-deer, the mouse-deer and numerous reptiles and fishes.

By this time bullock carts had replaced the automobiles, and carried food and duffle over winding bumpy trails further into the jungle. A base camp was organized on the river bank among big trees and elephant grass, where tigers more than once left their spoor a scant hundred yards away.

"Three weeks were spent in this locality building up collections until torrential rains, the beginning of the rainy season, drove us homeward to save the valuable collections already secured," says Doctor Clark. "Sizes of specimens varied from the giant water-buffalo weighing three thousand pounds to the tiny mouse-deer which weighed but four pounds. This specimen, a full-grown female, standing hardly eight inches at the shoulders with tiny hooves so small that they would hardly cover the rubber of a lead pencil, contained a fully developed foetus which by itself weighed almost half a pound. This interesting and valuable biological specimen with its entire envelope was saved as a complete formaline specimen. A large male and female elephant skull helped swell the collection, but no tiger, as the time necessary to secure this spectacular trophy would not have been justified in scientific value.

"In all, although the expedition spent only five weeks in the field, the results are most satisfactory. The preserved specimens were left in Saigon where they were packed for shipment directly to the American Museum."

Birds of the Congo and "Penguin Island"

Dr. James P. Chapin of the Department of Birds sailed for Belgium July 18th to continue work on the second volume of his "Birds of the Belgian Congo" at the Musee du Congo Belge in Tervuren.

* * *

Readers who remember Mr. Willy Ley's fascinating article "*The Great Auk*" (NATURAL HISTORY, November, 1935), telling how this flightless "north-penguin" was slaughtered into extinction, will be interested to know that on July 20, Thomas Gilliard of the Department of Birds, with Samuel K. George, succeeded in reaching Funk Island, the former metropolis of the Great Auk, thirty-four miles off Newfoundland. The absence of safe anchorage made it essential for them to embark four hours after landing. Nevertheless, they succeeded in collecting enough Great Auk bones to

construct at least one complete skeleton, and in taking a census of the other birds nesting on the island.

Reconnoitering for Bisons and Antelope

On July 7th a preliminary expedition under Robert McConnell accompanied by Robert Rockwell of the Museum Department of Arts and Preparation set forth to survey the antelope herds roaming the Wyoming plains about 60 miles south of Cody. Antelopes move in scattered groups in summer and their pelage is poor. Therefore no attempts were made to take specimens. With the approach of winter, however, antelopes segregate in larger groups, are more attractively furred and offer a wider selection to the collector.

After a few days in the antelope country, Mr. McConnell inspected the semi-wild buffalo herds maintained on the National Bison Range near Missoula, Montana, by the United States Biological Survey. These buffalo are permitted to retain their natural habits, and are protected from hunters. Mr. McConnell is making necessary negotiations with the Government for permission to obtain specimens of this herd for a proposed Museum group.

Apart from its initial objective of performing the requisite groundwork for a collecting expedition this fall, Mr. McConnell's survey corps was able to bring back with them several interesting species of birds and small mammals.

Plans are on foot to assemble a new Antelope-Bison group in the Museum's North American Hall, from specimens taken during the expedition contemplated this autumn.

Animal Life in the Rockies

Temperatures averaged 14° below zero last December, when Mr. George G. Goodwin studied wild life on the western slopes of the Rocky Mountains.

Colorado again lured the Assistant Curator of Mammals on June 19th, when he returned to the same section to continue his researches under summer conditions.

This project was made possible through the generosity of Mr. Harry Snyder of Chicago, who, with Mr. Goodwin, has made expeditions into northern and western Canada which have been recounted in NATURAL HISTORY (September, 1935, and May, 1936).

Swordfishing in Nova Scotia

Through the generosity of Mr. Michael Lerner, an expedition to the swordfishing grounds off Cape Breton, Nova Scotia, left New York on July 25th, under the auspices of the American Museum of Natural History.

The personnel of the expedition consisted of: Michael Lerner, John Treadwell Nichols, Curator of Recent Fishes; Francesca LaMonte, Associate Curator of Ichthyology; Harry C. Raven, Associate Curator of Comparative Anatomy; Miles Conrad, Assistant Curator of Comparative Anatomy; Ludwig Ferraglio of the Department of Preparation and Exhibition; and Anthony Keasbey of the Department of Ichthyology.

The Nova Scotian Government placed a large boat at the disposal of the expedition for collecting up and down the coast and adjacent islands, and also supplied a motion picture operator. During the last part of their stay, the expedition moved down to Wedgeport, Nova Scotia, for the big tuna run off Soldier's Rip, where it collected data for exhibit material in the Museum. A laboratory has been established at Louisburg for studies of the anatomy, food habits, and other data on the fishes of the region, particularly the swordfish.

Planetarium News

During the month of September the lecture in the Hayden Planetarium will be on the subject **TIME AND NAVIGATION**, including discussion of such points as time-keeping of the ancients, time and space, the elementary fundamentals of navigation, and the sky as a time-keeper, with discussion of the various kinds of time. During September there is to be in the Planetarium an exhibit of ancient and fine timepieces. The watch used by Lincoln Ellsworth at the South Pole will also remain on exhibition on the second floor of the building.

During September, on clear Tuesday evenings, a telescope will be available outside the Planetarium after the eight and the nine o'clock lectures for Planetarium visitors. The moon, the planets, and various other interesting sky objects will be viewed at these times.

Radio talks under the auspices of the Amateur Astronomers Association will continue over Station WHN, on Friday nights from 7:30 to 7:45.

The regular meetings of the Amateur Astronomers Association and the Junior Astronomy Club will commence again for the year 1936-37 early in October.

During September Jupiter is a bright object in the evening sky, setting about four hours after the sun. Saturn comes into the sky about sunset by the middle of the month and is in view all night. At this time it is at its maximum brightness for the whole year, magnitude 0.8.

Education Notes

During the last three weeks of July there was an exhibition in Education Hall of 52 water-colors of Panama's fruits and flowers by Mrs. Marie Louise Evans of Balboa Heights, Canal Zone.

An exhibition of the work done last summer in activity programs by children who attended the summer play schools and day camps of WPA 1563, under the supervision of the Board of Education, will be on view from Sept. 21st to Oct. 15th.

During July and August the Department of Education instructors accommodated about 5,000 children from the Play Schools of New York City. These youngsters were given an hour's instruction in the halls and an hour of motion pictures.

On July 13th, 20th and August 3rd three groups of young students from Germany totaling 125, were conducted through the Museum by special guides. Every year under the auspices of the West Side Y. M. C. A. groups of this type have been coming to the United States.

The American Museum of Natural History, through its Department of Education, will again offer a number of courses in cooperation with the colleges and universities of the city.

FREE COURSES FOR TEACHERS: *Methods of Teaching Geography* in an Activity Program by Mrs. Grace Fisher Ramsey; *The Museum in Elementary Social Studies* by Mrs. Ramsey; *Nature Study for City Teachers* by Miss Farida A. Wiley.

A new offering to teachers of New York City public schools is a course *Craft Techniques*, including Miniature Habitat Group Making, Finger Painting, and Nature and Geography Crafts. The brevity of the course does not permit the granting of alertness or college credit for the work.

Pay courses in Astronomy, by Dr. Clyde Fisher, will be offered by Hunter College and New York University. College or university credit will be allowed for all these courses, as well as alertness credit by the Board of Education.

The regular lecture courses for classes of public school children will be continued, including auditorium lectures for elementary school pupils, lectures in biologic science for high school biology students, exhibition hall talks, sight conservation talks, and specially arranged lectures and demonstrations in the Hayden Planetarium.

Free Saturday afternoon programs of educational motion pictures will be given for the general public at two P. M., beginning September 19th. At four P. M. on four consecutive Saturdays, starting October 24th, Mr. Herbert P. Whitlock will give a free talk on *The Appreciation of Gems*, including jade and amber.

Oceanic Birds of South America

Twelve hundred copies of Dr. Robert Cushman Murphey's two-volume work of this title were issued, after which the type was destroyed. At the date of issue of this number of **NATURAL HISTORY** less than one-third of the edition remains in stock. In all parts of the world the work has been received most favorably and has been awarded praise by bibliophiles as an extraordinarily fine example of printing, illustration, and format, no less than by scientific men for the excellence of its plan and text.

NOTE

An error occurred in regard to the volume and issue number on the binding of the June **NATURAL HISTORY**. The designation should be volume XXXVIII, No. 1, and subscribers who intend to bind the magazines are notified that the June issue should be placed at the beginning of the second volume of 1936 rather than at the end of the first volume as the erroneous figure might suggest.

Acknowledgment

Owing to an ambiguity in the official records credit was not correctly given in the January (1936) issue of **NATURAL HISTORY** for the procuring of the young bull elephant in the Akeley group. Opportunity is taken at this time to state that this animal was collected by Mrs. Delia J. Akeley.

RECENTLY ELECTED MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum:

Honorary Life Member

Mr. James Zetek.

Life Member

Mrs. William F. Sanford.

Sustaining Members

Mrs. William H. Good

Messrs. W. K. Kellogg, Noel Robinson, F. S. Streever.

Annual Members

Mesdames Harold Amory, Grenville Clark, Jessie Benedict Faye, Meredith Hare, Herbert Du Puy, James J. Lee, O. L. Loring, Richard H. Mandel, Howard E. Perry, William Clement Scott, I. De Ver Warner, Sylvan E. Weil, Frieda B. Winner, Richard W. Woolworth.

Princess Xenia of Russia.

Misses Ethelwyn Doolittle, Elisabeth Harris, Anne S. Richardson, Anna L. Slater.

Reverend John F. Ross.

Doctors Afranio do Amaral, John V. N. Dorr, Frances Holden, Robert L. Levy, Madge C. L. McGuinness.

Honorable James A. Fitz-gerald.

Messrs. Joseph Adams, Malcolm P. Aldrich, Charles L. Allen, Elliot S. Benedict, J. L. Berston, Corwin Black, Elmer G. Diefenbach, Joseph L. Fleming, E. F. B. Fries, Alfred Henry Friedman, William J. German, Alan Hazeltine, Carl T. Keller, Robert Meyer, George Oenslager, Rushmore Patterson, Stephen Peabody, Max Rosenwald, William H. Schroder, Lester S. Thompson, William Richard Townley, R. Alan Turner, Clark Williams, Dudley F. Wolfe.

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McGregor, Floyd J. Miller, W. A. Mitchell, J. E. Moore, George S. Munson, John M. Murray, Walter P. Muther, Karl Erik Nasmark, Herbert L. Nichols Jr., T. H. O'Brien, E. Ospina-Racines, Watson Parker, LeRoy W. Parsons, Southwick Phelps, Edwin T. Phillips, Fred J. Pierce, Walter G. Pomeroy, Kennett F. Potter, Fred J. Raffelson, Homer F. Rensch, Lee W. Reynolds, Royal P. Richardson, F. H. Rivers, W. B. Roberts, P. H. Robertson, Edmund B. Rogers, Morrison Rogers, George Bowyer Rossbach, F. A. Schaff, F. S. Selby, David Rives Sigourney, Elihu A. Silver, E. J. Simonek, Berry Cushing Smith, Earl E. Smith, Lee Smits, Albert H. Sonn, E. B. Sprague, Guy H. Stanton, Theo. E. Stebbins, Henry H. Stickney, Otto Stoll, John H. Storer, Hans Ris Studphil, Irving Stutz, Richard C. Sullivan, John A. Sutro, G. Arthur Swan, C. G. Teitsch, Ben H. Thompson, H. R. Turner, George H. P. Van Alst, Bernard Van Ingen Jr., Walker Van Riper, J. Varley, Howard H. Warner Jr., Wm. H. Welsh, Harry Sylvester Wender, Fred G. Whaler, George W. Wheelwright, Lawrence Whitcomb, Charles L. Williams, Murphy M. Williams, Wm. W. Wood, J. H. Woods Jr., W. D. Craig Wright, Christian C. Zillman Jr.

Frank Richard Oastler

HUNDREDS of men and women in this city and throughout America are mourning the passing of Dr. Frank Richard Oastler. A grandson of Sir Daniel MacNee, one time President of the Royal Academy of Edinburgh and a great grandson of Sir Richard Oastler, he achieved distinction as a physician and surgeon and for many years was chief surgeon of the Lenox Hill Hospital and professor of surgery in the College of Physicians and Surgeons of Columbia University. Men and women in all walks of life will long remember his professional skill and they will treasure equally his great spiritual qualities which led him to a sympathetic understanding of the serious problems of their personal lives. When he had given to his patients from the best of his medical knowledge and experience he still had much in reserve for them. Not unlike the Great Healer, he sustained those who depended upon him by the very essence of his own spiritual life. No one ever left his counsels without a stronger faith in themselves, a better hope for the future and a firmer belief in the goodness of life.

Unless one knew of the personal life of Doctor Oastler he might well wonder at the man's incredible vigor, his boundless optimism and his astonishing youth. When still a young man and realizing the need for a balance to offset the rigors of his professional life, he sought and found refreshment for his mind and body and sanctuary for his soul in the wildest and most beautiful mountains of the West. Each summer for more

than a quarter of a century he spent three or four months traveling by pack train along the great rivers, over the flower-filled alpine lands and across the great glaciers and high passes of the American and Canadian Rockies. In the course of time he and his wilderness-loving wife came to know almost every peaceful valley, deep canyon and rugged peak along the Great Divide between the Colorado and the Yukon. All these natural beauties of landscape and the wild creatures of the rocks and the forests he photographed and he became a master of the photographic art. The rare trumpeter swan at nesting time along the shallows of some mountain lake; the big horn sheep in his high fortress among the cliffs; the beaver busy in the construction of his river home; the woodland caribou, the moose, the elk, ranging amid dark forests of spruce and balsam—all these and a host of lesser creatures became his friends. Thousands of feet of film and colored slides of wild life and virgin country were his dearest treasures—and even more, the memory of the wilderness which they recalled. Using his film and slides in his lectures for charity, he raised large sums for the alleviation of human suffering.

Ardently opposed to the hunting and killing of animals for sport, he fathered the conservation of the wilds and was primarily responsible for the creation of several of our National Parks. This great nature lover "lifted up his eyes unto the hills" and drank deep of their streams of inspiration.

—MARY L. JOBE AKELEY

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Men die, are executed, tortured . . .
But the Idea is immortal."*

"TRAIL Blazers of Science" is a magnificent tribute to the tenacity of the human organism in the face of every conceivable physical torture and spiritual mortification. It first appeared in Germany under the title of "Das Leben Fur Die Idee." Mr. Edwin Schuman has given a faithful and gifted translation whose sensational title may be defended on the grounds that the book's message will reach a larger audience.

With the following words the author epitomizes the great, sad, *Leitmotif* that recurs with Wagnerian solemnity throughout the pages of his book:

"The world allows itself to be converted to its true forward steps only reluctantly. Animals take fright suddenly and become accustomed slowly. *Mischief has another, quicker dynamic than benefaction.* The good deed lacks the moment of terror with which the evil deed paralyzes the understanding and entralls the heart. Out of this difference is born the world's unrighteousness."

It is a sickening tragedy of human existence, that the men whose brains propel the very lifestream of our civilization, must, in the name of precedent, be bodily and spiritually crucified by blundering contemporaries. The author's task is to tell of the lives of certain heroes of world and scientific history in such a way that they become the protagonists of progress in "the bitter warfare between myth and knowledge." Laity will be unfamiliar with many of their names—but the task is admirably fulfilled. Doctor Gumpert is articulate to the point of artistry, as well as being a sound scholar and an able scientist.

The heroes are grouped according to the centuries in which they lived. Starting with the 16th,

there are Cardan, Vesalius and Servetus, all more or less brutally victimized by religious intolerance.

In the 17th Copernicus and Kepler investigate the heavens, and Swammerdam, the world of insects. The dawn of man's evolution is discovered by Wolff and LaMark in the 18th. Robert Mayer is confined in an asylum for the insane because he published the law of the conservation of energy; Jackson and Morton fight bitterly for the credit of discovering ether anesthesia, and Von Pettenkofer lays the foundations of modern hygiene, in the 19th.

Despite Dr. Harvey Cushing's incontestable brilliance, and the great benefits his work has undoubtedly bestowed on mankind, your reviewer deplores the author's selection of him as the hero of the 20th century. This great brain surgeon does not seem to be the rightful heir to the crown of pain that passed inexorably from one to the other of the preceding heroes. Doctor Cushing saw little of the bitter opposition, and downright oppression of his illustrious forebears. True, he was scoffed at—but he was not expatriated, strait-jacketed, or burned at the stake. Encouraging though this may seem, it lends a note of false security to the facility of progress in our own times.

For, all too often, dark forewarnings of a growing reaction against intellectual achievement are filtering into current news reports. Organizations at Doctor Gumpert's doorstep are carrying out programs of religious persecution which have discriminated against some of the world's most enlightened minds.

No. The human race has not yet learned to detect its benefactors. *Mischief* has still "another, quicker dynamic"—and all is not well.

You feel somehow, that the 20th century held out a challenge to Doctor Gumpert, before which he faltered. It is not denied that the difficulties of fact-gathering would be enormous and the risks, tremendous. Then, too, he would probably suffer the very indignities and griefs he so righteously laments in the lives of his heroes. There would be a curious justice in that—but one, Doctor Gumpert does not wish to contend or explore. Because of this, his life will be, perhaps, simpler and happier—his book, truly brilliant—not truly great.

THROUGH THE TELESCOPE

- - - - - by Edward A. Fath

McGraw-Hill Book Co., Inc., \$2.75

NO doubt there are many admirable books for the beginner in Astronomy, and for those whose interest is merely casual. But this is certainly one of them.

Since Edward A. Fath, who is professor of astronomy in Carleton College, is the author also of an excellent textbook of astronomy—a standard, somewhat technical work—his credentials are in order.

Through the Telescope, however, is anything but technical. It is eminently for the layman. Professor Fath points out that he wished to include no more than could be read in one evening by a reasonably rapid reader. In this he has succeeded, for his style allows of swift and pleasant reading. It is friendly and easy, though never careless; light, almost breezy. One finds a minimum of "science" and a maximum of what is curious, and essential, and human in astronomy.

The book is amply illustrated with well chosen drawings and photographs.

The reader is taken, in imagination, on a journey to two great observatories, the Lick and Mt. Wilson. Through the giant telescopes there he makes his acquaintance, evening after evening, with one celestial character after another—a novel way of making first contact with the sky, and a good one.

The writer points out later, in speaking of a minor planet, "It would be impossible to have a baseball game on the asteroid, for every long hit would drive the ball off the asteroid altogether. The ball would never return but would swing around in space as a separate minute planet in an orbit around the sun."

Significantly, Professor Fath sub-titles his book, "A Story of Astronomy." It does not pretend to be the complete story of astronomy. Many such stories must be written before the tale would be fully told. But as a story it is heartily recommended.

—ARTHUR DRAPER

GREEN LAURELS

- - - - - by Donald Culcross Peattie

Simon and Schuster, \$3.75

"The living world as you came to it with the ardor of first love."

THAT lush style of Mr. Peattie's, so fragrant, so plump with adjectives, will whip city-dulled sensibilities to a tingling new awareness of Nature, will open the eyes of the young novice, will strike tremulous chords of emotional recognition in the sensitive soul.

Skeletally, "Green Laurels" is a mere collection of biographies. But the body of the book, the central theme, is "man's mind as it is concerned with Nature."

Mr. Peattie begins with the Medieval herbalists—and their first tiny emergence from the dusty gloom of ever-reiterated Aristotle. The progress of Malpighi, Swammerdam and Leeuwenhoeck is deftly traced. Then on to the decadent court intrigues of the pouting Pompadour, and the part she played in the lamentable feud between Buffon and Reaumur.

He tells how the green world unfolded under the nordic eyes of Linnaeus; how LaMarck lived, learned, and died, and of Cuvier's opposition to him.

Swiftly, then, the book turns to that vast laboratory of the Naturalist—the New World. How Michaux and Bartram, the wilderness plantmen, fared therein, and how Wilson and Audubon studied and sketched under harsh difficulties.

Comes the bizarre career of Rafinesque, and that of the hopelessly impractical Thomas Say.

Back in Europe, he toys amusingly with the "rose-water teleology" of Goethe and the Romanticists. Thence to Darwin, and Wallace and the familiar tale of the world's reception of the evolutionary theory.

Jean Henri Fabre is his last figure. Lovingly the author extols the courage and fortitude displayed by the naive, little Frenchman in his devotion to the cause, amid the most depressing domestic heartbreak.

That its author discloses nothing the practising Naturalist could add to his store of information is not to be deplored. It is enough that the book should stimulate an interest in those spiritual rewards to be won by intelligent contemplation of plant, bird, and animal life in all its infinite variety. Science must have its popular apostles. And Mr. Peattie might perhaps be styled as ace "contact man" for botany and ornithology.

HARPOONER - - - by Robert Ferguson

Univ. of Pennsylvania Press, \$2.50

"Large oyster shells as big as wheelbarrows"

SIMPLICITY with the ring of truth fills the pages of this whaler's diary making of it a vital document on a now vanished way of life.

Mr. Leslie Dalrymple Stair's editing is to be commended for its admirable restraint in preserving intact the impressions and activities of Robert Ferguson as they were actually recorded during his voyage on the ship *Kathleen* from 1880 to 1884.

A python's gaping jaws, the horror of an Arab slave market, brawls on shore and at sea—all these and much more he describes in addition to the authentic technique of his precarious profession.

Almost automatically, one calls to mind Richard Henry Dana's "Two Years Before the Mast." But Ferguson is no Harvard man (his formal education ended at the age of 9) and his prose is as free of the polished rhetoric of that classic as it is of the mysticism of Melville.

It is curious indeed, that this simple, God-fearing seaman should achieve fine literary effects by a

style whose verbal economy so markedly resembles the studied medium of certain noted writers of our own day.

"AN ODYSSEY OF THE ISLANDS"
- - - - - by Carl N. Taylor

Scribner's, \$3.00

"No sounds . . . save the splash of fish or crocodiles, the sucking of stealthily moving feet in the mud, and an occasional cry of some raucous, night-flying bird."

MR. TAYLOR gave up a job in the university of the Phillipines at Manila with the idea of devoting a month to arduous travel through the islands lying beyond the scope of the white man's civilization. His odyssey lasted more than a year. At once a story of high adventure and an unflattering commentary on the arbitrary attempts to superimpose one culture upon another, it is narrated with surpassing skill and a certain masculine charm.

Readers who prefer their explorations untainted by sensationalism will not be disappointed in the author's treatment. He was determined to write an utterly honest report of human life as it exists in the little-visited sections of the Philippine archipelago, and, undaunted by danger, hardships or fever, has achieved a well-deserved success.

Starting from the southernmost end of the islands, his odyssey took him, by devious out-of-the-way paths, to the extremities of Luzon in the northeast. In its course, he joined in the almost Neanderthal hunts of the pygmy Negritos, was "cured" of dysentery by the weird contortions of a Sea-Gypsy Medicine Man, sought gold in the domains of chronic head-hunters, and most impressive of all, saw minor civilizations, drifting, before his very eyes, toward inevitable extinction.

His camera was always with him, and the abundant original photographs are worthy companions of the text.

Mr. Taylor has few panegyrics for the civilizing processes contrived either by the Spanish or the United States governments. He says, at one point, "I was trying to think of some blessing that the Government had bestowed upon these people who had gotten along and prospered for forty centuries by their own efforts." He ridicules the absurdity of teaching children of the indomitable Morro outlaws to reverence "a pale little boy with a hatchet . . . who was not ingenious enough to tell a necessary lie, a trait of character foreign to the oriental nature, which not even their Christian teacher can understand."

The author is not a confirmed opponent of every well-intentioned, albeit clumsy, effort of the Philippine administration to "improve" the natives. His is simply a plea for a truly enlightened program. It is a curious justice that permitted the author, in a sense the patron of subject peoples, to die last February, by the hand of his houseboy, while at work on an investigation into the rites of the Penitentes in New Mexico.

HOW TO USE YOUR MINIATURE
CAMERA - - - - - by Ivan Dmitri

The Studio Publications, N. Y.

TO the person contemplating the purchase of a Leica miniature camera, or to the recent owner of the same instrument this book makes a valuable starting point. The opening pages are devoted to a minute discussion of the mechanical operation of the Leica. The instructions go so far into the taking of pictures as to show the effect of each of the various lenses obtainable.

Perhaps the most valuable part of the book lies in the second part that contains the illustrations. It is here that the beginner starts to appreciate the field of the miniature camera in catching "life on the wing." The unposed "candid" photographs of animals and babies as well as unusual speed shots of performers on the stage display the wide variety of subject matter open to the miniature camera enthusiast. Exposure data and information of interest about unusual conditions under which the picture was made are given for each picture so as to help improve the judgment of the miniature camera user when confronted with a difficult subject.

—CHARLES H. COLES

DESOLATE MARCHES by L. M. Nesbitt

Harcourt Brace, \$2.50

" . . . read the tale in my ragged clothing and bleeding hands and my unquenchable thirst."

PESTILENTIAL flies that lay sight-destroying eggs in the corner of the human eye, myriad ticks that bore and feed in the skin, vampires that suck the blood of sleeping victims, these and many other spawn of the Venezuelan jungle make "Desolate Marches" a well-named book.

An untimely Alpine death has cut short the promising career of its author, L. M. Nesbitt, engineer, traveler, adventurer—and above all a writer so gifted as to merit comparison with W. H. Hudson. No more, will he plod, stricken with fever and dysentery, behind the swinging machetes of his trail-breakers. He has surveyed his last wilderness, written his last book, and a noble mind has passed from among us.

"Desolate Marches" is a worthy legacy.

Frankly autobiographical, it is the story of his surveying expedition in the region of the Orinoco basin. On this framework is woven an unforgettable display of the frightful squalor and degeneracy of the natives, together with a few vagrant whites, who, forsaken by their own civilization, sink likewise to the brute level, crushed by the invincible jungle.

The prevailing grimness is, however, not unrelieved. Here and there he comes upon an amusing or admirable being—and his descriptions of the natural surroundings are eminently beautiful. He makes pets of many of the animals and birds, and despite his sufferings and discomforts, expresses, at the end, a genuine regret to leave the verdant wasteland that held so great a fascination for him.

CHILE: LAND AND SOCIETY

- - - by George McCutchen McBride

American Geographical Society, \$4.00

"... a New World Country with the social organization of old Spain; a 20th century people still preserving a feudal society . . ."

MR. McBRIDE'S impressively documented yet readable volume is an impartial and scholarly analysis of the vast social problems facing the Chile of today.

Chile has its grandees—*hacendados* they are called, most of whom trace their ancestry back to the original holders of the *encomiendas* (land grants from the crown during the colonization period). So deeply entrenched is their hereditary position of ownership, that a Chilean authority has declared: "In Chile there exists a greater monopolization of the agricultural land than in any other country of the world."

The soldier forefathers of the *hacendados* wrested the country from the Indians, settled on large royal grants, and remorselessly forced the conquered people into vassalage. So began this long dynasty of overlords. Indeed one may describe Chile's history as the history of its *hacienda*.

Each *hacienda* is a remarkably self-sufficient unit. It has its own blacksmith, wet nurse, seamstress or veterinary, and its store sells tobacco and light wines to the laborers. The latter have often lived all their lives on the *hacienda*, as had their fathers before them. They are between 75-90% illiterate and until this generation it has not been attempted to make them otherwise. All opportunities for education and culture are open only to the *hacendado* and his family.

At the outset of the twentieth century this two-class system of "Master and Man" began to disintegrate. Periodic need for workers in the mines and nitrate fields, and other causes created a class of nomad laborers, who go about the country selling their labor power. A third estate of small farmers, and a few isolated, collectively owned communities arose. Lastly, due to increased exports, room for industrial labor was effected.

It thus became increasingly apparent that the *hacienda* system had outlived its usefulness.

Mr. McBride traces the stormy history of Chile's politics; shows how in every crisis, the *hacendados'* interests gave ground only grudgingly—and concludes that there is a very real danger of their losing all their lands, if they do not consent to the equitable redistribution of part of them.

The book is by no means exclusively a compendium of the economic history of Chile. Its author writes admirably of the people themselves, of his personal contacts with them and their work. He tells of the land they live in; its sprawling mountain ranges, teeming forests, and varied climate. He supports his text with a large number of interesting photographs and maps, that enable the reader to gain a nice picture of a turbulent and colorful nation.

HOW ANIMALS DEVELOP

- - - - - by C. H. Waddington

Norton, \$2.00

HERETOFORE, the embryologist has concerned himself with the problem of observing and recording with descriptive accuracy each phase of embryonic growth and differentiation. Mr. Waddington centers his discussion in the as yet unsolved problem of what makes animal tissues develop and integrate as they do.

The most striking discovery brought to the reader's attention is that of the apparent existence of one or more "organization centres" within the tissues, determining the character of the specialized organs which become differentiated in the individual. Mr. Waddington cites as an example that when frog's skin is grafted experimentally into the mouth of a newt, it becomes induced to form a mouth, apparently due to the presence of an "organizer" determining the nature of the organ demanded in that area; but the skin, having come from a frog, is only competent to form a frog's mouth, which it therefore forms in place of the totally different mouth of the newt.

Such discoveries as this suggest the complexity of interaction in living tissues and the difficulty of discovering completely the causes underlying embryonic development. Mr. Waddington is optimistic in his view of experimental embryology, and his book *How Animals Develop* looks forward to future clarification of the field.

WITH PLANE, BOAT, AND CAMERA IN GREENLAND - - by Dr. Ernst Sorge

Appleton Century, \$5.00

"Loneliness makes a man reflective; hardship sharpens his insight; suffering steels his will to conquer; these things educate him to full manhood."

THIS book is a description of the German expedition to Greenland in 1932, which had the double purpose of: (1) filming the fiords as background for two motion pictures, "S O S Iceberg" and a comedy; and (2) the scientific examination of the fiords and glaciers.

Sinclair Lewis has somewhere lampooned a travel book with the description "trickles of mint-flavored text around large raw hunks of illustration." Apart from some thoroughly interesting observations on, and experiments with, Greenland's glacial deposits, Doctor Sorge's prose and photography produce the reverse effect. The many cooling photographic inserts (which might be called mint-flavored) are most remarkable for their depiction of glacial phenomena, particularly the "calving" of the Rink Glacier.

Doctor Sorge made three trips to this glacier. The first time he lost his collapsible boat and was stranded. But, with spartan calm and courage, he

faced eight days of privation and hand to hand grappling with the frozen wilderness aided only, mind you, by a gasoline stove, a thermos bottle, a waterproof sleeping bag, canned milk, pea soup, corned beef, pumpernickel, butter, blutwurst and coffee. And was finally located, fed, and rescued by an airplane. "It is odd," he remarks, "how soon a man can accommodate himself to a situation when there is nothing to be done about it, particularly when he is strong and fit."

The book contains very readable accounts of Eskimo life, splendid descriptions of the landscape, and is rich in highly informative material on the glaciers.

Indeed the descriptions and documentation of the book are important contributions. One only wishes that the Herr Doktor had not seen fit to justify almost every activity of the expedition, from the importation of zoo-reared polar bears for photographic purposes to the needless icy plunges of actress Riefenstahl, on the basis of his chest-thumping Prussian ideology.

LISTEN FOR A LONESOME DRUM

- - - - by Carl Carmer

Farrar & Rinehart, Inc., \$3.00

ANCIENT Seneca ritual, performed within sight of the glowing sky above the countless electric lights of Buffalo; glimpses of spiritual life one hundred miles from Manhattan where religion is not a narcotic, but a stimulant, an aphrodisiac; Red Men without faith in seemingly benevolent government legislature; White Men renouncing the federal constitution on the grounds that it nowhere mentions God; under-graduates handling game cocks; spiritualist mediums, the descendants of Noyes' communist stirpiculture;—all these Carl Carmer has found in New York, Empire State of the union.

He says, "Here men, wondering at words spoken from the bodiless air, listening for a lonesome drum, have sent their minds beyond the realm of experience, where, like eager hawks, they have seized on shining prey and brought it triumphantly to earth. Let theologians and philosophers weigh the trophies. It is enough for some of us to know the hunters and to hear the tales of the hunting."

That, it seems to your reviewer, is the fault with this book. Mr. Carmer seems to accept it as fact that the people of whom he writes, are such as they are, through causes too tenuous and fragile for the categories of science.

He has given us an unbiased, searching account of human existence throughout upper New York State. He has set down its folkways with painstaking accuracy, mimicked the various speech idioms, learned the songs, jokes, and legends of each locality; in short, done a beautiful and vigorous job of reporting. But these up-staters are for the most part, ignorant, backward people. The residents of the Bristol hills, the Chenango people, and the sundry "cracker box" characters that abound in the book—present the picture of a culture that has fallen deplorably short of its potentialities.

Frontier days and ways are remarkably alive—and this would seem, in a state that boasts the largest, most technically advanced metropolis in the world, quite as much a chiding commentary on America, as a eulogy of its multifarious modes of living.

"Listen for a Lonesome Drum" in the final analysis is an excellent and honest sociological document, artfully written by a man who reveals himself but sparingly.

HIGH TRAILS OF GLACIER NATIONAL PARK

by Margaret Thompson

The Caxton Printers, Ltd., \$3.00

BOUND by hand, beautifully illustrated and written, this book is a refreshing example of individual craftsmanship.

Smoothly, with the effortless appeal of a good writer who knows her subject, Miss Thompson reveals the panorama of grandeur that is Glacier National Park, touching upon the history of its development, its people, and the wild life that abounds within its borders.

She makes a singularly well documented plea for a more enlightened treatment of the American Indian. She shows how, in an astoundingly short period of time, these tribes were reduced from a virile, independent people to a burden on the public dole. Since they are citizens, why, she contends, could they not benefit by legislation at least as progressive as that enjoyed by their conquerors?

Miss Thompson's book will appeal to any one interested in nature. The sportsman, the geologist, the artist and the anthropologist—all will find moments of delight in her pages.

THE CONQUEST OF YUCATAN

- - - - by Frans Blom

Houghton, Mifflin Co., \$3.50

"THE history of the greatest civilization of ancient America is like a gigantic jigsaw puzzle of which we only have some pieces."

Frans Blom, of Tulane University, is a leading authority on the Mayas, and his book is a beautifully contrived attempt to reconstruct their culture, as well as being a memorial to the Yucatan that existed before the coming of Spain, armed with cross and sword.

GEOGRAPHY, AN INTRODUCTION TO HUMAN ECOLOGY

- - - - by C. L. White & G. T. Renner

D. Appleton-Century, \$4.00

A THOROUGHLY readable work in which the author lifts geography out of the realm of factual compilation, and applies to social geography the succession concept introduced into botanical ecology by Cowles.

DOGS, CATS AND MONKEYS
- - - - - by Rene Bache

Dorrance & Co., \$1.25

ANY animal fancier, particularly one whose interest lies chiefly in dogs, cats and monkeys, will find curious little gems of information, which together with the many delightful anecdotes and tales of animal heroism, make this volume one of the more illuminating in its field.

TREASURES IN THE EARTH
- - - - - by Edward F. Fitzhugh, Jr.

The Caxton Printers, Ltd., \$2.00

"MORE tangible, more awe-inspiring than ever, and extremely useful." Thus Mr. Fitzhugh describes the science of geology. In lucid, fast-moving, and what is important to the lay reader—non-technical language, he shows the applications of scientific knowledge and methods to the mining of "Treasures in the Earth."

COMPARATIVE PSYCHOLOGY, VERTEBRATES
- - - - - by T. N. Jenkins & L. H. Warner

Ronald Press, \$4.50

A COMPREHENSIVE treatise, comprising a bibliography of 199 titles, on the psychology of the vertebrates from fish to ape. This book sums up the developments in the field of comparative psychology since the time of Darwin.

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STUDIES OF THE YAQUI INDIANS OF SONORA, MEXICO
- - - - - by Holden and Others

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A POPULARLY written group of reports on the interesting aspects of the life of this tribe.

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- - - - - A Diary by Eric P. Quain
G. P. Putnam's Sons, \$2.00

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2 June, 1936

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Vol. LXXI—The American Land and Fresh-Water Isopod Crustacea. By Willard G. Van Name.

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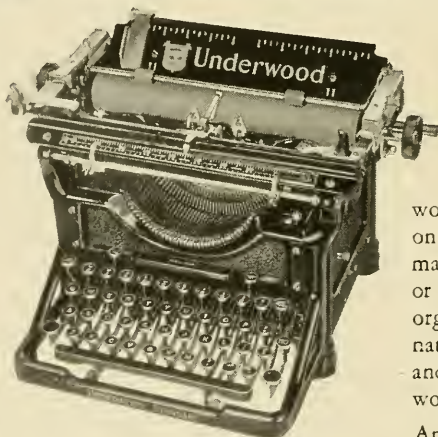
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NATURAL HISTORY

The Magazine of the American Museum of Natural History

VOLUME XXXVIII

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OCTOBER 1936

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Behind that Door

A résumé of some of the world's strangest and most interesting occupations "behind the scenes" at the American Museum

By ROY CHAPMAN ANDREWS

Director, American Museum of Natural History

THE American Museum of Natural History is not only a vast "place" with twenty-three acres of floor space, an average of twelve thousand visitors a day and housing, besides its exhibits, a whole village of nearly a thousand people engaged in such diverse activities as tanning hides and manufacturing electric power to measuring insects under a microscope and forging metal cases. It is an immense FORCE, adding bit by bit to the sum of human knowledge, gathering its information through research and exploration and disseminating it through its publications, lectures, radio broadcasts and its Department of Education.

Largest in World

Unlike many other institutions of its kind, the American Museum of Natural History will take you behind the scenes where you may gain a new insight on the myriad problems involved in running the largest institution of its kind in the world. Any member of the Museum, or properly accredited visitor, may obtain a pass through that door marked, "Public Not Admitted."

When he steps through that door what does he find? First, that any organization of this size, though it be devoted to science, in its practical details comes under the head of Big

Business. The Museum has its own power plant that supplies light, heat and ice for all of its buildings. It requires the entire time of two men just to replace electric light bulbs and clean the glassware of lighting fixtures in these buildings. The cost of these bulbs alone amounts to \$5500 a year. Akeley Hall, which is still only partially completed, with many of its exhibits unlighted, requires \$1100 worth of bulbs a year.

In the basement there is the Carpenter Shop, where fourteen men are employed every work day of the year making all carpentry repairs and office alterations, doors, cases, furniture and picture frames necessary for the Museum. Next to it is the Machine Shop with its fifteen permanent employees, who are kept busy doing all the iron work, forging and roofing, the repairing of locks and machinery, the making of metal exhibition cases as well as special metal work for the Curators. It was the foreman of the Machine Shop, Jacob W. Shrope, who, under the direction of Dr. Roy W. Miner, invented the waterproof camera case for undersea photography.

Sharp-shooters

Beside the Carpenter and Machine Shops are the Electrical, Plumbing, Paint and Masonry Shops. It requires the full time of six masons to keep the tiled floors and other stone and brick work of the Museum in repair. Few visitors know that in its basement the Museum maintains a shooting range where the men who guard its treasure practice marksmanship at regular intervals. In addition to the regular armed guards distributed throughout its halls, special guards protect the Morgan jewel collection twenty-four hours of the day. This hall

(Left) One step in the long process that brings science to the public eye: a Museum Sherlock Holmes studying a fragment of a reptile long-since vanished from the earth

has an individual electric alarm system and when it is closed to the public the guard is locked in.

One of the busiest departments "behind that door" is the Print Shop. Started in 1903 with one man and a hand press, this Department has grown to such proportions that most of the Museum's publications, including *Natural History Magazine*, which was handled by our own printing press and bindery as late as 1934, have had to be sent to outside printers. And still the Print Shop has trebled its output since that date. Here are just a few of the items it turns out: booklets for the Department of Education, *Junior Natural History Magazine*, all circular work and stationery used in the Museum and all labels that accompany the specimens throughout the exhibition halls. This last alone is a formidable item. Two orders in one day called for seven hundred and sixty different labels. Besides its regular work, the Museum press has printed the first volume of the late Professor Henry Fairfield Osborn's *Proboscidea Memoir*.

Before taking the elevator to the upper floors perhaps you would like to visit the Shipping Room, through which pass all the express, freight and other heavy goods that enter or leave the Museum. Through its prosaic doors pours much of the glamour of travel and exploration. Among the daily average of fifty incoming shipments are motion picture film, crates of fossil bones, Museum supplies and live animals. The latter, mainly frogs, turtles, lizards and snakes—the poisonous ones come wrapped in burlap inside a crate—are destined for the experimental laboratory. Frequently when

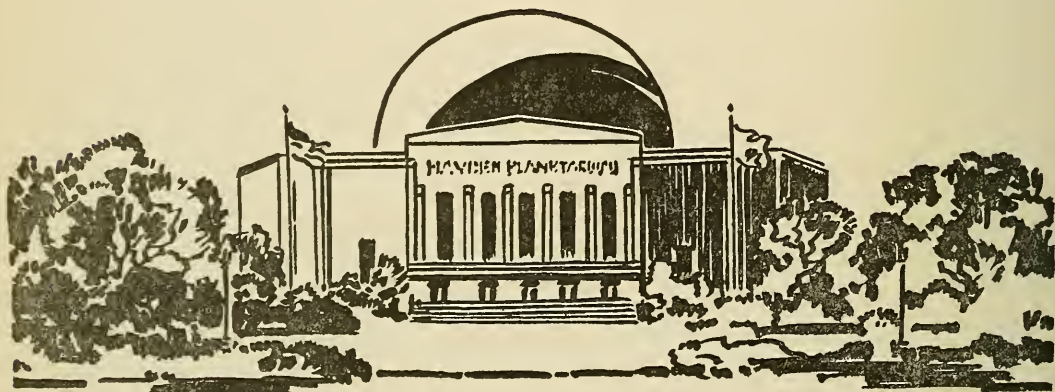
some animal dies at one of the City's zoos the Shipping Department truck calls for it and brings it to the Museum where it is used for research work. Here too, all expedition equipment is packed, or crated, and sent to the interior of Africa or the coast of Patagonia. All skins and other material sent or brought in from foreign countries comes, under bond, to the Shipping Room where it is examined by the Custom's officials.

If you take the elevator from the basement you are politely told at the fourth floor that there are no exhibits above this floor. The fifth floor is "behind that door." Here a totally different sidelight may be obtained on the vast and varied activities of the Museum. On your way to the Library you must pass the Mail Desk which handles, besides all incoming and outgoing letters, about three hundred publications and from ten to twenty packages a day. Among the latter are specimens sent to the Museum for exchange or identification by scientists or amateurs from all parts of the world. In one day's mail there may be a live toad from Colorado, a dead snake from Borneo, fish, minerals, bits of meteors or bones. Many of these are gifts to the Museum and are turned over to the proper department when they can be used. The Mail Desk occasionally receives a well-intentioned offer of a donation for which it can suggest no recipient, such as that of a woman who brought in a pet dog which she was going to have destroyed and inquired if the Museum would like to have the pelt.

The Museum Library with its one hundred and nineteen thousand volumes, while pri-

HAYDEN PLANETARIUM

Drawn by Joseph M. Guerry



marily maintained to provide reference literature for the scientific staff, is frequently used by visiting scientists, writers, artists, explorers, representatives of commercial firms and students in their search for special information, references or illustrations on some subject pertaining to natural history. Here one may meet such well-known explorers as Admiral Byrd, William Beebe, Lincoln Ellsworth and members of expeditions going to Sumatra, the Bahamas or the South Pole getting in advance the information on climatic, geologic and hygienic conditions necessary for their trip. Artists, commissioned to make cover designs or illustrations, come to the Museum Library in search of such material as "jungles in Java" or "domestic cattle grazing in Palestine." A motion picture producer consulted the Library regarding the kind of cart to be used in a Rudolph Valentino picture with a South American background. The Library also co-operated with an automobile manufacturer and a silk manufacturer in the production of two expensive catalogues advertising new color schemes based upon exotic birds, fish, minerals and gems. Industrial research laboratories, writers of travel pamphlets, compilers of encyclopaedias and newspaper and scientific editors are among those who meet behind that door.

Jigsaw puzzles in bone

On the same floor is one of the most interesting rooms in the Museum, the work shop of the Department of Paleontology. When the visitor to the Dinosaur Halls sees the skeleton of some prehistoric animal it looks as though it had risen complete from its million-year-old grave. The fact is that it may be composed of twenty thousand fragments of bone that have taken months, even years, to piece together bit by bit like a jigsaw puzzle. In the work shop these bits of bone are spread out on long tables and sorted into separate piles by experts who can tell by the texture and appearance to what part of the animal each fragment belongs. Patiently these pieces are fitted together and glued with a composition of paper pulp. In some cases the bones are found in comparatively soft substance but when they are imbedded in rock they must be removed with the aid of fine dental instruments and microscope.

Before leaving the field every effort is made to find the entire skeleton. Where this is im-

possible, the missing parts are reproduced in plaster. In the case of a recent remarkable discovery by Dr. Barnum Brown of the remains of a prehistoric stem animal—the first of its kind ever to be found in the United States—a half inch section of the femur was discovered to be missing. The following year another expedition was made to the same spot. Three weeks were spent in the field and eight tons of earth and débris sifted through a fly screen and washed. The result was enough small pieces of bone to cover the bottom of a cigar box, among them the missing half inch of femur. There is no school except experience in which to learn the technique employed in the Paleontology work shop. Many of the men engaged in this work have been developing and perfecting their methods through more than thirty years of practical experience in the Museum. The result of their labor is casting a new light on the history of the world.

Artistry in glass

From the reconstruction of mammoths and mastodons it is but a few steps to the Tower Room where microscopic organisms are being magnified and accurately reproduced in glass. Mr. H. O. Mueller, the Swiss glassblower who has been with the Museum for more than forty years, has perfected a technique so individual that his exquisite replicas of delicate microscopic invertebrates are not only of inestimable value to the student of natural science but in themselves are works of art. In the Tower Room too, are made the lifelike fish one sees in the exhibition halls. Plaster casts, measurements and paintings are made of living fish in their natural environment. From these, exact reproductions are made of wax and other materials and painted by expert artists.

One of the questions most frequently asked by visitors to the Museum is, "are the trees and flowers in the habitat groups real?" A visit to the Preparation Department, which occupies an entire building, will answer that question for you. Although constant development of new technique and the invention of new methods by the scientist, artists and engineers on the Museum's staff are taking place in every department, progress is perhaps most marked in the Preparation Department. From the days when animals were stuffed with sawdust, and cotton leaves were purchased from

a millinery supply house, to the artistic perfection of the recently opened Akeley African Hall, with its startlingly lifelike groups, indirect lighting, invisible glass and architectural perspective, is a matter of a few years, and yet this advance, growing out of the inspiration of the late Carl Akeley, has been brought about by the Preparation Department of the American Museum of Natural History under the leadership of James L. Clark and his Associate Chief, Albert E. Butler.

Animals frozen solid

The groundwork for the mounting of animals and the reproduction of background is done by the expedition in the field. Plaster casts, measurements, motion pictures, still pictures, paintings and samples of rocks and plants as well as the bones and pelts of the animals form the basis for the work that is carried on and completed in the Museum. A large refrigerator room on the fourth floor of the Preparation building takes care of the perishable specimens until they are ready to be mounted. It is also used to freeze solid in lifelike poses whole dead animals for study by the staff sculptors. Opposite the refrigerator room is the tannery where the stiff, salted skins arriving from the field are transformed into smooth, supple pelts, as easy to work with as fabric. These are no longer "stuffed" but fitted onto a plaster cast of a sculptured animal.

Whenever possible, real tree trunks, plants and grasses are used after having been dried and having their color restored with an air brush. In most cases, however, they must be reproduced in wax, glass, celluloid or other materials. So accurately and skilfully is this done that only a close comparison with the original will betray the difference. The new elliptical niches used in the Akeley Hall habitat groups presented a problem in painting background scenery which was solved by James K. Wilson, architect and artist on the Preparation staff. As an animal, tree or other object painted on a curve would appear foreshortened to anyone standing in front of the exhibit, a chart must be made before painting in the background to determine the exact proportions that will appear natural to the spectator.

On the Preparation staff are such artists and sculptors as William R. Leigh, Robert H. Rockwell, Ludwig Ferraglio, whose sculptures

have been exhibited in the National Academy, F. Lee Jaques, widely recognized as the finest bird artist in America, with many exhibitions to his credit, Vincent Narahara and many others of national reputation.

Although not executed by the Preparation Department, the Coral Group, in the Hall of Ocean Life, presented one of the most unique and difficult problems in preparation and engineering. You may have stood before this reproduction of a coral reef in the Bahamas to admire its sheer beauty or to study it with a scientific eye but perhaps it would have been even more interesting if you had witnessed its construction behind that door. To the visitor this Coral Group—the first ever to be installed in any museum—appears to have been brought to life intact instead of requiring twelve years of complicated and difficult work.

Non-floating paint brushes

Dr. Roy W. Miner led five expeditions to the Bahamas to make the studies and collections for this group. Twelve hundred still pictures were taken, four thousand feet of motion picture film and seventy colored sketches. The latter were made by the artist Chris Olsen who worked undersea in a diving helmet. All of his equipment had to be weighted—to let go of a paint brush meant it would promptly float to the top. The coral itself was collected, bleached and packed in four weeks. To bleach the coral it was laid on the beach and water poured over it constantly to wash off all material clinging to it and then left in the sun to dry. Three thousand square feet of lumber were used for packing.

As there was no precedent for making such an exhibit, many original problems in engineering and technique had to be solved by patient experiment and ingenuity on the parts of Doctor Miner and Mr. Chris Olsen. One of the most difficult to overcome was the problem of disguising the steel construction where the coral did not cover it and at the same time not destroy the translucent appearance of water. A great variety of materials had been tried and found unsatisfactory when one day, as a joke, a friend of Mr. Olsen's presented him with a roll of a cellophane and wire mesh combination, used by farmers for the windows of chicken coops. It proved to be the perfect solution.

Few visitors to the Insect Life Hall realize the interesting work that is carried on "behind that door" to maintain the living insect exhibit. Live insects, like humans, have to eat. As their diet consists mainly of other insects, a veritable incubator and nursery is necessary to preserve this endless chain. Here, cockroaches and crickets are raised on bran; slices of potatoes and apples serve as food for the tarantulas. Flower beetles, which are fed on dog biscuits and whole wheat flour, become in turn food for other insects. The praying mantis, which is raised for exhibition, prefers live flies and meal worms. To make the meal worm appear more lively and therefore more tempting to the mantis, he is dangled on the end of a piece of thread like a marionette. The tarantulas are perhaps the most spectacular and hardy of these charges. One of them has been living in the Museum for more than nine years, apparently satisfied with his hand-raised diet but without visible improvement in disposition.

Every department has its problems behind the scenes which the visitor seldom suspects. When we read of people being prostrated by a heat wave we hardly think of insects as being similarly affected. And yet, a particularly hot spell last July raised havoc with the "nursery." Many of the inmates died and others became sickly. The bees that are kept on exhibition give the least trouble unless something unusual happens. In winter they are fed sugar syrup but in summer a panel in the wall adjoining their case is left open so that they can forage for themselves in the City's parks. However, occasionally an emergency arises as when recently several days of damp weather caused the

wooden frame of the case to warp. A steady stream of bees flew out into the Hall through the crack between the frame and the glass side of the case and were captured with difficulty.

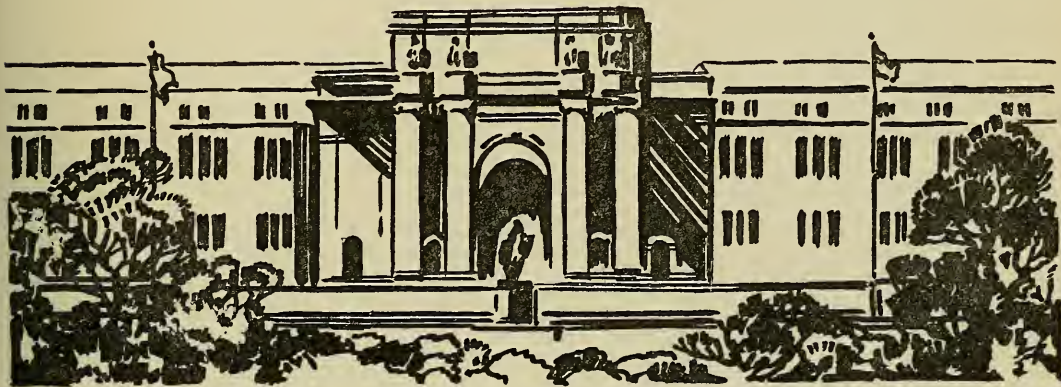
The living insect exhibits not only play an important part in the educational work of the Museum but they form the basis of study for airplane designers, commercial artists (an advertising firm, handling the advertising for a nationally known insecticide, recently sent a representative to study the living insects), textile manufacturers as well as students of natural science.

But even more important to the work of the Museum are the living animals maintained, not for exhibition, but for study and experiment by the Department of Experimental Biology. Step into the huge elevator at the end of the African Building, an elevator designed to carry such objects as mounted elephants, and ascend to the roof. There you will find a series of what appear to be greenhouses with the warm, humid atmosphere of Malaysia or Brazil. Rows of aquariums filled with exotic looking fish; glass cases in which close scrutiny reveals the sharp eyes of a lizard or snake between the leaves of tropical plants; cages of frogs, rats and other small animals fill a large part of the glassed enclosure. Under the direction of Dr. G. K. Noble, these living creatures are studied for their habits, their reactions under varying conditions and for what light they may throw on the still existing mysteries concerning man himself.

Every now and then the Department receives an uninvited guest, as happened one day last spring. A live snake was discovered in a

ENTRANCE, ROOSEVELT MEMORIAL

Drawn by Joseph M. Guerry



small traveling case that had been deposited on a refuse can in the neighborhood. The astonished apartment house superintendent who found it, not knowing what else to do with it, brought it to the Museum where it was given temporary shelter in the Experimental Laboratory. Three days later an article appeared in a newspaper stating that a professional dancer had mislaid the pet snake which played an important part in her act. The lady was notified and the snake returned to its rightful owner.

740,000 birds

Research is a vital function of every scientific department of the Museum, and the Department of Ornithology maintains an entire building for the purpose of research and study, not only for its own large staff, but for visiting scientists and students. A fact that the average layman may be unaware of is that birds mounted and kept in cases are lost to science because their color fades and they cannot be handled and studied. The new Whitney Wing of the American Museum of Natural History now contains the largest collection of birds for study in the world. Forty-eight years ago the collection comprised 300 birds. It now has 740,000. These are kept in series of trays in special modern, insect-proof cases that close with pressure against rubber to keep out moisture, vermin and dust.

On each floor are special work rooms for visiting ornithologists as well as the offices and laboratories of the staff. To the Whitney Wing also come textile designers of automobile upholstery, ribbons and other fabrics to study the bird skins for new colors and patterns. What appears to the casual observer to be a monotonous warehouse of white enameled cases becomes an exciting experience when he is taken behind that door for a glimpse—with even “an uninitiated eye”—at how these unmounted birds are used to unfold the secrets of migration, environmental influence and variation, to add to our knowledge of the life history of the world.

The Department of Anthropology, of which Dr. Clark Wissler is Curator, can exhibit only a fraction of its thousands of specimens relating to Man and his development and history. One must go “behind that door” to visit the unique “library” where thirteen thousand human skulls, representing the natives of every

part of the world, are filed for research in labelled boxes and arranged like books on a library shelf; or to the room of life masks, where shelf after shelf contains the plaster likenesses of every race and type. Among those who come to study the research collections are surgeons, dentists, specialists in pediatrics and sinus ailments as well as anthropologist and students of anatomy. Maintained for research, also, are the library of specially recorded victrola records of native tribal music and rooms containing the implements, pottery, clothing and ornaments of the primitive peoples of the earth. The latter have specially designed doors and, as a precaution against insects, are periodically filled with poison gas, which is allowed to remain for several hours and pumped out.

So much of the work of this Department is conducted behind the scenes that few may realize the infinite amount of patience and labor involved in the making of an accurate model of a Mayan temple, a miniature life group of natives, or the restoration of a pottery urn that was found in a hundred scattered fragments. It is in the workrooms “behind that door” that these bits are pieced together and the models made.

Animals great and small

No less interesting are the research workrooms of the Department of Mammalogy, presided over by Dr. Harold E. Anthony and the members of his staff. Here the skulls, skeletons and skins of mammals—from the tiniest shrew to the full-grown elephant—are stored and catalogued for study. There are one hundred thousand complete specimens in all. From twenty to thirty of each species are necessary for making scientific comparisons. The student who wishes to study the development of the tusk formation in elephants may compare thirty specimens of all ages, from a newly born elephant to the fully mature animal. Many of the smaller mammals are also preserved in alcohol for study of the soft parts.

From this Department advice and information is often sought by furriers, glove manufacturers and other commercial firms as well as students of science. Wholesale furriers bring in samples of fur for identification. Usually, although head, feet and other distinguishing features are missing, the scientist has little dif-

ficulty in determining their origin. In one case recently, however, a real problem was presented by a sample of a consignment of furs which was finally proved to be unborn reindeer. Others, manufacturers of imitation fur, come to study and photograph patterns which may be copied in plush and other fabrics and many seek information regarding the abundance of fur-bearing animals in different parts of the world.

At the end of a long hall in the main building is the office of Dr. Chester A. Reeds, Curator of Geology. This Department is constantly being asked for advice and assistance by the public. During the construction of the huge piers on the west shore of Manhattan Island for the Queen Mary and Normandie, when slides occurred, Doctor Reeds was called in consultation. Every day's mail brings samples of rock or meteor for identification, requests for information and applications for employment. One of the latter recently lightened the day's labor. A college student wrote that she would like to be "the Curator and Librarian of the American Museum of Natural History" and wanted to know how she should go about preparing for the position. One of the many problems of this Department is the misunderstanding of its work in the field by property owners. In taking samples from a clap pit in New Jersey, it was necessary to make test holes in the bottom of the pit to determine the depth of the clay. Some time later the owners had several feet of clay dug from the bottom of the pit and as it was below sea level it promptly filled with water. It required a great deal of explaining to convince the owner that the geologist's activities were not responsible for the flooding of the pit.

The "Drama of the Skies"

Not only the world we live in but the universe surrounding it comes within the scope of the Museum. Since it was opened to the public in October, 1935, more than seven hundred thousand people have witnessed the "Drama of the Skies" in the Hayden Planetarium which is both a theater and a school for those who are interested in astronomy. In spite of the great number of people who come to witness the magic of an invention that can accurately reproduce the skies as they appeared to the Wise Men of Judea or as they will ap-

pear to our great-great-grandchildren, an increasing activity is developing behind the scenes. The Hayden Planetarium Bulletin, the official publication of the Planetarium, dealing with Astronomy, has grown from a slim pamphlet into a mature, full-sized magazine. The periodic, national radio broadcast brings enthusiastic letters from every part of the United States and Canada. And the Junior Astronomy Club is becoming known throughout the country. Its members have already taken an important place in astronomical circles. A member of the Student Science Clubs of America with headquarters at Pennsylvania State College, the Junior Astronomy Club has its club room in the Planetarium building. It is one of the many features of the Museum that takes place behind that door.

Exploration

There is probably no single branch of the Museum work as interesting to the public as its expeditions. Aside from the great scientific value of collecting specimens and studying their environment at first hand, exploration has a magic appeal to the adventurous and unadventurous alike. The first organized expedition sent out by the Museum was one from the Department of Mammals and Birds in 1886, when Dr. Daniel G. Elliot and Jenness Richardson went to Montana in search of material for the Bison Group. In the past two years the American Museum of Natural History has sent out more than forty-eight expeditions to all parts of the world. Among others, the Vernay-Hopwood expedition explored Burma and Malaysia for rare specimens and a motion picture record of the gibbon. The Templeton Crocker expedition, in the yacht, "Zaca," sailed the South Seas to study the background of the Polynesians. The Sage expedition brought home the giant panda from West China and Dr. Barnum Brown flew twenty thousand miles over the Western United States to make an aerial survey for traces of prehistoric life.

The big game scientific expedition differs from the sportsman's hunting expedition in many respects. The scientific expeditionary party usually includes a geologist, artists, photographers, taxidermist as well as hunters and the native guides and porters. The motor truck has largely replaced the great number of na-

tive porters that formerly were necessary. The game to be shot is carefully selected so as to get perfect specimen animals and the skins are brought home, not as trophies, but to be mounted for scientific exhibition and study. Here are just a few of the items of expense connected with such an expedition to Africa. A one way passage to Nairobi, the headquarters for most African big game hunting, costs approximately one thousand dollars. And that is only the beginning. To hunt lions, zebra and antelope there is a license fee of five hundred dollars for each gun. To shoot an elephant in its native jungle, the hunter must pay an additional one hundred dollars. Guides cost about two thousand dollars a month, depending upon the size of the party, for each individual in the expedition. Their charge includes the supplying of native porters, food and automobiles. The type of gun used for killing elephants costs in the neighborhood of five hundred dollars. In many countries the shooting of game is now highly restricted and all sorts of permits are necessary. Many animals are fast becoming extinct through the encroachment of civilization. Their preservation in such institutions as the American Museum is highly important to the scientific education of future generations.

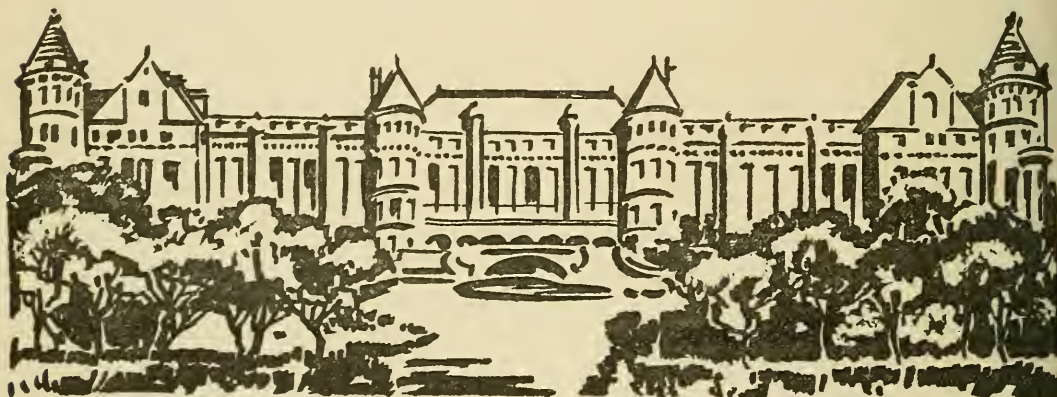
To pass on to the public the information it gains through research, experiment and exploration is one of the primary functions of the Museum. As the late Professor Osborn said, "It is not enough that scientists should know. It is important that people should know." Through its scientific papers, Publicity

Bureau, Natural History Magazine—a subscription to which is included in every membership in the Museum—other popular publications and its Department of Education, the Museum maintains a constant flow of outgoing information into every state in the Union and most of the civilized countries of the world. The work of its Department of Education alone, is so vast that it would require an entire volume to describe what takes place behind that door. When the distribution of nature study collections and photographic slides was begun in the early part of the century it required the services of one messenger. As the Department increased its scope, a horse-drawn wagon was hired from a nearby livery stable. Today, the Museum keeps seven automobile trucks in constant operation to deliver its educational material in New York City alone. Outside of New York, photographic material, including still and motion pictures, was sent to forty-one states, Alaska and eight foreign countries during the past year.

The name of General Goethals will go down in history as the builder of the Panama Canal. But every man who wielded a pickax or interpreted a blue print was vitally necessary to its accomplishment. The American Museum of Natural History is playing an important part in the enlightenment of the world in the science of natural history. It could not do so without the loyal co-operation it has received from its members. Every member, whether an associate member or an endowment member, is contributing his bit to the progress of civilization.

SOUTH FAÇADE, AMERICAN MUSEUM

Drawn by Joseph M. Guerry

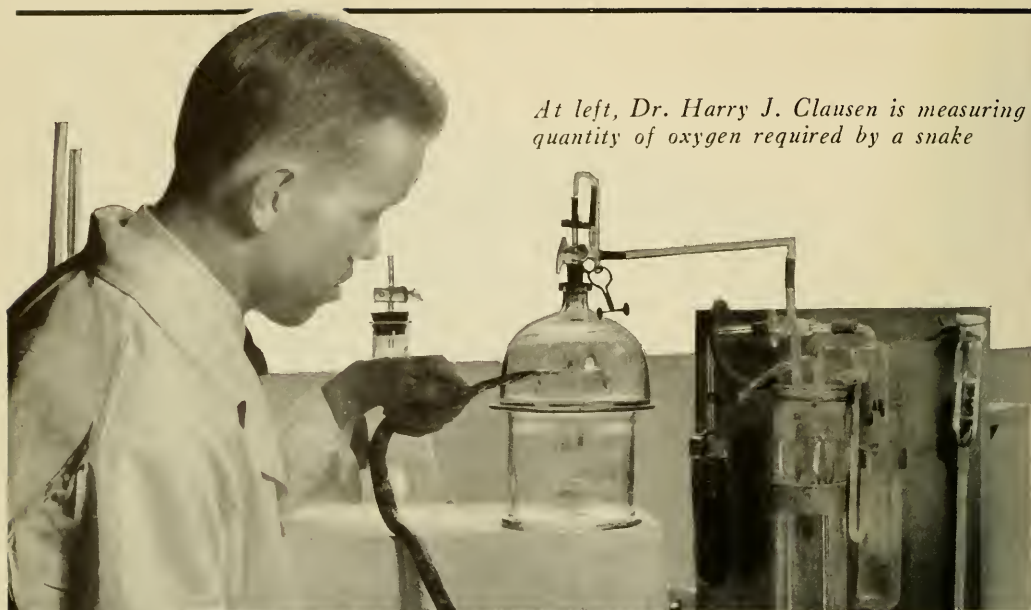




Behind that Door

The American Museum of Natural History invites its members to inspect the veritable village of nearly a thousand people who labor "behind the scenes" to the end that science may be advanced and interpreted to the public

At left, Dr. Harry J. Clausen is measuring the quantity of oxygen required by a snake

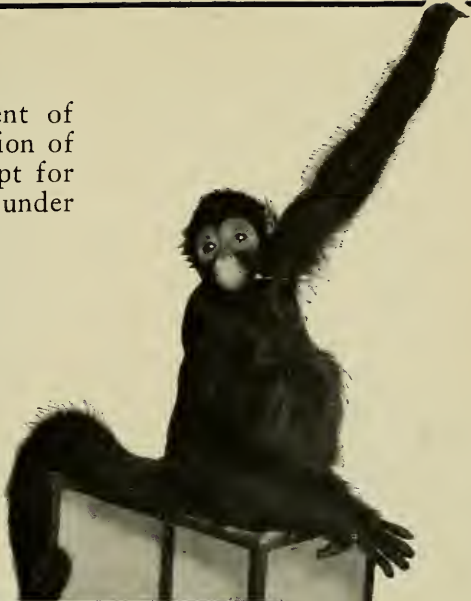


(Above) Breaking a hunger strike: force-feeding a snake who refuses dead food

(Right) Pampered inmates. The overhead pipes provide each table with ice water, hot water, and water of controlled temperature

A wide variety of foods must be stocked to suit the dietary habits of the laboratory's inmates. (Above) White worms being fed to fish under observation

In the American Museum's Department of Experimental Biology, under the direction of Dr. G. K. Noble, living animals are kept for the study of their habits and reactions under varying conditions



(Below) A lunch of earthworms for terrapin



(Above) An interested spectator in the Department of Experimental Biology

(Left) Water babies: An experimental tadpole in each dish, studied under uniform temperature



(Right) A Museum carpenter. A force of fourteen are kept busy making furniture, picture frames, cases, and other appurtenances



(Below) Machinery whirrs in the Museum workshop. Special apparatus for the curators is here constructed in addition to the extensive repair work that is done



Music of the spheres: mechanical overture produced behind the scenes for the appearance of the stars in the Hayden Planetarium



(Below) Fred Raiser testing for perfect reproduction





(Left) Storing fur "coats": T. Donald Carter of the scientific staff hanging skins in moth-proof cases. Whole dead animals are frozen solid in life-like poses in a large refrigeration room for study by staff sculptors

Mounting a cormorant: Raymond B. Potter, one of many experts constantly striving to improve the methods of taxidermy



(Below) President F. Trubee Davison examining one of the 740,000 bird specimens which make the Museum's collection the largest for study in the world





(Above) A jig-saw puzzle in animal history: fragments from which an extinct creature will be reborn, illustrating the complexity of the task which confronts Dr. Barnum Brown (right) and his assistants when a shipment is brought back from the field



(Left) The skeleton of a mountain zebra takes form under the skilful hands of S. H. Chubb, Associate Curator in Comparative and Human Anatomy

(Right) A prehistoric clue is analyzed through the microscope: Albert Thomson preparing the jaw of an ancient mammal. Experience is the only school in this work, and many of the men engaged in it have been developing their methods for more than thirty years in the American Museum



(Right) One stage in the reproduction of an extinct animal: Otto Falkenbach piecing together the skeleton of a fossil reptile



(Below) Shark in plaster



"Are the trees and flowers in the groups real?" visitors frequently ask. Some are, but Museum artists can reproduce them so accurately that they cannot be distinguished from the real objects and last much longer. At left you see G. Frederick Mason, whose cover designs are familiar to NATURAL HISTORY readers, turning his hand to the making of an artificial cactus

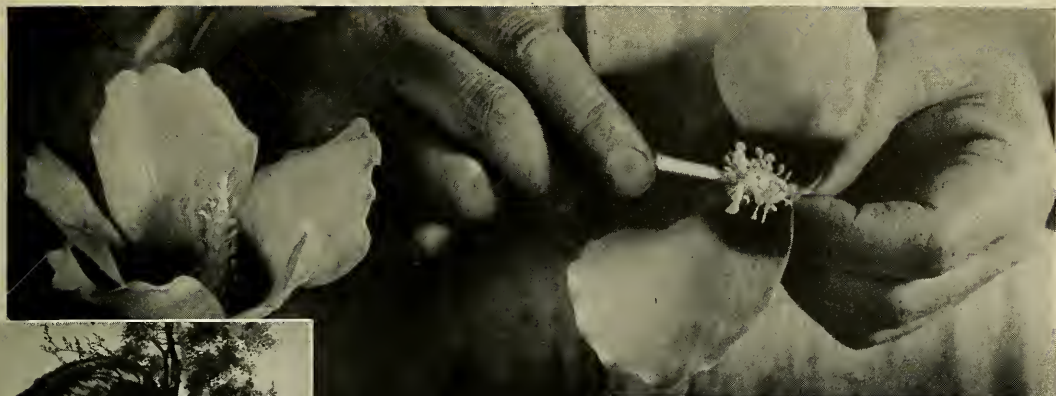
Birch bark industry in miniature: Mr. Narahara mak- (cont. below)



ing one of the interesting models of native life produced by the Department of Anthropology, under the direction of Dr. Clark Wissler

(Right) Fish that never swam. But in the Coral Reef Group, where they were put after Bruce Brunner completed them, many mistake them for real ones





As many as a thousand artificial flowers are sometimes made for a single habitat group. Leaves are even more numerous, there being a hundred thousand in a single exhibit



(Above) Microscopic anatomy rendered in blown glass: a small marine worm reproduced on a grand scale. (Left) The glass blower at work: Herman Mueller, who has pursued his distinctive art for more than forty years in the American Museum



The Museum library, one of the many resources open to members of the largest institution of its kind in the world

Here one may see such well-known ex-

plorers as Byrd, Beebe, Ellsworth and others. Writers, artists, motion-picture producers and research workers from commercial firms also make use of its 119,000 volumes

The Eclipse in Kazakhstan

Eye-witness account by the American Museum's representative, who traveled 16,000 miles to study a spectacle lasting less than two minutes

By CLYDE FISHER

*Curator, Astronomy and the Hayden Planetarium,
American Museum*

BY early dawn—and dawn comes early on June 19th, in latitude 51 degrees North—there was a stir of quiet activity in the various units of the expedition, making the last tests of focus and performance of instruments. At first the sky was partly cloudy, causing much uneasiness, especially on the part of those who had traveled half-way around the world to observe the eclipse. In the course of a few hours, however, the eastern part of the sky, where the sun would be located for us, became entirely clear, much to our relief.

Effect on man and animals

Exactly at 8:11 a. m. local time, as computed by a member of our party, Mrs. Isabel M. Lewis, of the U. S. Naval Observatory, the moon's disk made the first contact on its trip across the face of the sun. Since the moon revolves around the earth from west to east, the eastern edge of its disk first contacts the western edge of the sun's disk. In a little more than an hour the moon had moved entirely between us and the sun. As the sun's crescent became thinner and thinner, a weird darkness came on, a phenomenon which affects both man and animals. It is practically certain that the chorus of bird-songs, which we had enjoyed for many days around our eclipse camp ceased temporarily, that the ever-present skylarks suspended their ecstatic flight-songs—but I am sure that no member of our expedition had time to observe the behavior of either man or animals.

The ghostly and elusive shadow-bands, which usually appear a few minutes before and after totality, were not pronounced. I had seen them well on the snow at the eclipse of January, 1925, and was watching for their appearance here. At two minutes before totality I took my last look for them on the walls of our white-canvas optical tent nearby, and did not see them. They were observed, however, by Dr. Donald H. Menzel and by Mr. J. A. Pierce.

Weird twilight

The darkness increased and delicate colors developed. The dark purple of the rolling steppes to the westward just before totality was unforgettable. The sky became dark greenish-blue, with a band of salmon-orange just above the horizon. Just as the last bit of the sun was covered, and with great suddenness, the finest spectacle ever observed by man was before us. The exquisite corona, generally considered the most beautiful feature of an eclipse of the sun, became visible as a five-pointed star with very long streamers, probably interpreted by many inhabitants of the U.S.S.R. as a symbol of the Soviet star. As expected the corona approached the sunspot maximum type, in which the polar and lateral streamers are of about equal length.

At the base of the corona, unusually high prominences could be noted with the unaided eye; at least six could be counted, one of which must have been nearly 100,000 miles in height; two large ones were so close together that they might have been regarded as a double prominence.

Venus shone out brilliantly about two degrees above the sun and a little to the right,

adding much to the spectacle. Mars, though much fainter than Venus, was seen to the left of Venus and closer to the sun.

The Baily's Beads, produced at the beginning of totality by the last rays of the sun shining between mountains or other irregularities of the moon's surface, and at the end of totality by the first rays of the sun shining through such irregularities, were especially fine at the end of totality, giving the gorgeous "diamond-ring" effect.

A few months before the eclipse of June 19, 1936, I was invited to join the Harvard-M. I. T. Expedition by Dr. Harlow Shapley, Director of the Harvard Observatory, seconded by Dr. Donald H. Menzel, also of the Harvard Observatory, who was to be leader of the expedition.* My acceptance of this attractive invitation was made possible by the generosity of Mr. Charles Hayden, godfather of the Hayden Planetarium.

The path of totality extended from a point in the Mediterranean Sea off the southwest coast of Grecian Peloponnesus, where the eclipse began at sunrise, thence across Greece, European and Asiatic Russia, Siberia, Northern Japan, and out into the Pacific Ocean, where the eclipse ended at sunset.

On Asia's steppes

The station selected for the Harvard-M. I. T. Expedition was located on the Kirghiz Steppe in Kazakhstan in west-central Asia, nine miles east of Ak-Bulak, a town of 9000 inhabitants. The homes here are low, one-story houses made of adobe bricks and with adobe roofs—a quaint old town with very wide streets. Here are to be seen more ox-carts

*The entire personnel of the expedition was as follows:
Dr. and Mrs. Donald H. Menzel of Harvard,
Dr. and Mrs. Joseph P. Boyce of Massachusetts Institute of Technology,
Mr. Henry Hemmendinger of Harvard,
Miss Henrietta Swope of Harvard,
Mr. and Mrs. A. H. Benfield of Cambridge, England,
Dr. and Mrs. R. D'E. Atkinson of Rutgers University,
Dr. and Mrs. Wallace R. Brode of Ohio State University,
Miss Catherine Stillman of Vassar College,
Dr. and Mrs. I. C. Gardner of the Bureau of Standards,
Mr. Paul King of the Cruft Laboratory of Harvard University,
Mr. H. Selvidge of the Cruft Laboratory of Harvard University,
Mr. J. A. Pierce of the Cruft Laboratory of Harvard University,
Mr. E. P. York, of the Cruft Laboratory of Harvard University,
Mr. Jackson H. Cook of Massachusetts Institute of Technology,
Miss Marguerite O'L. Crowe of New York State Board of Health,
Mrs. Isabel M. Lewis of U. S. Naval Observatory,
Mrs. Lucy T. Day of U. S. Naval Observatory,
Dr. Clyde Fisher of the Hayden Planetarium of the American Museum of Natural History.

and camels than automobiles. In fact, the entire water supply of our camp was hauled by a Siberian camel complaining every step of the way. The actual eclipse camp was situated upon an ancient Chude burial mound, which gave a fine outlook over this rolling steppe country. Since Ak-Bulak is not shown on most maps, it may be well to state that it is located southeast of Orenburg, home of the famous Orenburg Shawls.

The similarity between this steppe country and the Great Plains of the Dakotas is striking, and the summertime weather is much the same, that is, extremely continental. The mornings are usually clear, but toward noon or especially in the afternoon, light-colored cumulus clouds appear, having been formed *in situ*, becoming more and more abundant—beautiful for photographic effects, but distressing if they should cover the sun at eclipse time. So, it was fortunate that the western end of the long path of totality was chosen as our location, for here the eclipse occurred in mid-forenoon (totality lasting from 9 hr. 15 min. 20 sec. to 9 hr. 17 min. 17 sec., local time), not only a good time of day for the probability of clear skies, but also a good elevation for astronomical observation. In fact, out of six mornings immediately preceding the eclipse, four were perfect for observation. For a period of two or three weeks just before the eclipse, the record was much more promising.

Many expeditions

On adjoining ground was located the principal expedition from the Poulkovo Observatory near Leningrad, under the leadership of Professor B. P. Gerasimovich. The Poulkovo Observatory also had a branch expedition located near Omsk. Professor Gerasimovich, who spent a few years at the Harvard Observatory, is not only director of the leading observatory in the U.S.S.R., but he was assigned by the Soviet Academy of Sciences to arrange for all the expeditions in his country. Hence, it may be said, that we were close to headquarters, and the proximity to Professor Gerasimovich and his expedition added much to the pleasure and profit of our work.

Forty expeditions were scattered along the path of totality in the Soviet Union alone, of which 28 were from the U.S.S.R., and twelve were foreign. The latter included two

from America—the Harvard-M. I. T. and the Georgetown University-National Geographic Society—French, British, Italian, Polish, Czechoslovakian, Dutch, Swedish, and Chinese. There were other expeditions in Japan. We were extremely sorry to learn that the Georgetown University-National Geographic Society Expedition, which was located at Kustenai, Kazakhstan, was frustrated by clouds.

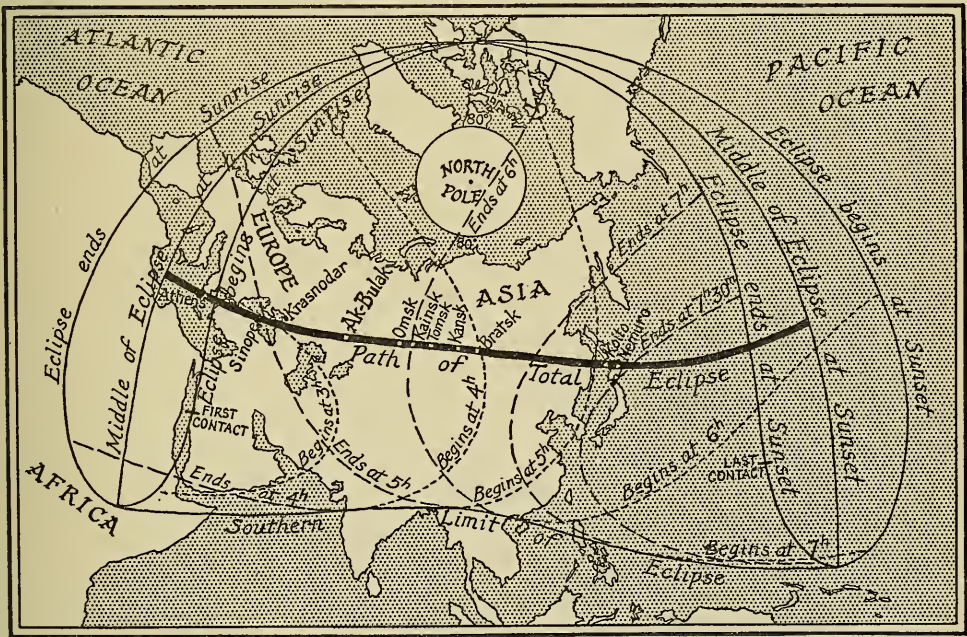
Most of the work of the Harvard-M. I. T. Expedition was spectrographic in character, and the results can not be known for months. In fact, the results of most of the expeditions can not be known for a long time. About all that can be said at the present time is that most of the parties had a perfect opportunity.

The Soviet expeditions, which were scattered from European Russia to Eastern Siberia made definite plans to study possible changes in the corona during the sweep of the eclipse eastward along its path. Although such studies had been attempted before, they had never

been made with exactly the same kind of instruments, using the same kind of plates, to be developed under the same conditions.

Results of the test of the Einstein Effect will be awaited with interest by many astronomers, for there are still some scientists who feel that the test of the bending of the rays of light from the stars when passing near the sun has not been satisfactorily met. Professor A. A. Mikhailov of the Sternberg Astronomical Institute of Moscow had charge of this work. He had clear skies in Khabarovsk Province, and made photographs of the star-field around the sun, with his camera of original design which will, it is hoped, make possible the elimination of the errors that arose in previous observations. Eight months later after the sun has moved to another part of the sky, Professor Mikhailov plans to photograph the same star-field for comparison.

K. N. Shistovsky, Technical Director of the Moscow Planetarium, planned to fly to an altitude of 10,000 meters in a sub-stratosphere



By D. F. Levett Bradley
Adapted from U. S. Naval Observatory map

EXTENT OF ECLIPSE

The heavy line shows the regions where the eclipse was total. It was from the town of Ak-Bulak that the American Museum's observer, Dr. Clyde Fisher, studied the spectacle. The

dotted and dashed lines indicate the hour (Greenwich Civil Time) at which the eclipse began and ended in various parts of Asia and Europe

balloon, at the village of Otrada Kubanskawa, North Caucasus. His objects were to photograph the on-coming shadow of the moon with a motion-picture camera, and to make spectrograms of the flash-spectrum and corona. When I talked with him about his project before the eclipse at the Moscow Planetarium, he was much interested to know that I had photographed the on-coming shadow of the moon with the Akeley motion-picture camera at the eclipse of 1932. Although I have not yet heard what results Mr. Shistovsky secured, I should expect much from him. He is a very able and resourceful technician, having invented several outstanding accessories for the Moscow Planetarium, namely, the sunrise-after-dawn device, the twinkling-star apparatus, the strip-map for use in changing latitude, the Northern Lights device, and a solar-eclipse apparatus.

Animal behavior

So far as I know the first organized and directed project for the observation of the behavior of animals during an eclipse, was carried out by members of the Young Naturalist's Clubs of the schools with the cooperation of Professor P. A. Manteufel, Director of the Moscow Zoo. The preliminary results of these observations, which have been reported by the press, have brought many communications on the subject from various parts of the U.S.S.R. Professor Manteufel, who is a trained research scientist as well as a lover of animals, will edit these and publish a paper on the subject.

While in Moscow on my return from Asia, I attended a motion picture theatre in order to see the Soviet news-reel of the Eclipse, which I understood was being shown throughout the U.S.S.R. I knew that it had been made at Ak-Bulak, but imagine my surprise when the picture opened with Clyde Fisher cranking the Akeley Camera! In fact, this photo-naturalist appeared in the picture in three different places. And the Explorers Club flag showed up finely.

The Academy of Sciences of the Soviet Union is to be congratulated upon its most extensive educational campaign in connection with the eclipse, which was so thoroughly promoted and carried out. Every member of the Harvard-M. I. T. Eclipse Expedition owes a debt of gratitude to the Academy of Sciences and to Professor B. P. Gerasimovich for their

generous and untiring help in making our project a success.

One of the amazing discoveries made before the dawn of history by the ancient Chaldean watchers of the sky was that eclipses occur in cycles, the series repeating itself every eighteen and a fraction years, this period having been named by them the *Saros*, signifying repetition, and by this name it is still known to astronomers. Thus it has long been possible to forecast eclipses with considerable accuracy, though not with the refined accuracy with which it is now done by the Nautical Almanac Office of the U. S. Naval Observatory and by similar agencies in other countries.

An eclipse can occur only at the new moon phase when the moon is at or near one of its nodes, that is, one of the two points of intersection of the moon's orbit and the plane of the ecliptic. These two points or nodes, however, do not stay put, but travel westward, in a slow precessional movement which carries them clear around the sky in eighteen and a fraction years, and this determines the length of the *Saros*, or Eclipse Cycle. The exact length of the *Saros* is not an integral number of years and days, but is eighteen years, eleven and one-third days (or ten and one-third days, if the interval contains five leap-years). The one-third of a day allows the earth to turn one-third way around on its axis, and this makes the corresponding eclipse of the next *Saros* take place about 120 degrees west of its previous counterpart. Consequently it will require three of these *Saros* periods, or a little more than fifty-four years, before we have another total eclipse of the sun in this part of the world.

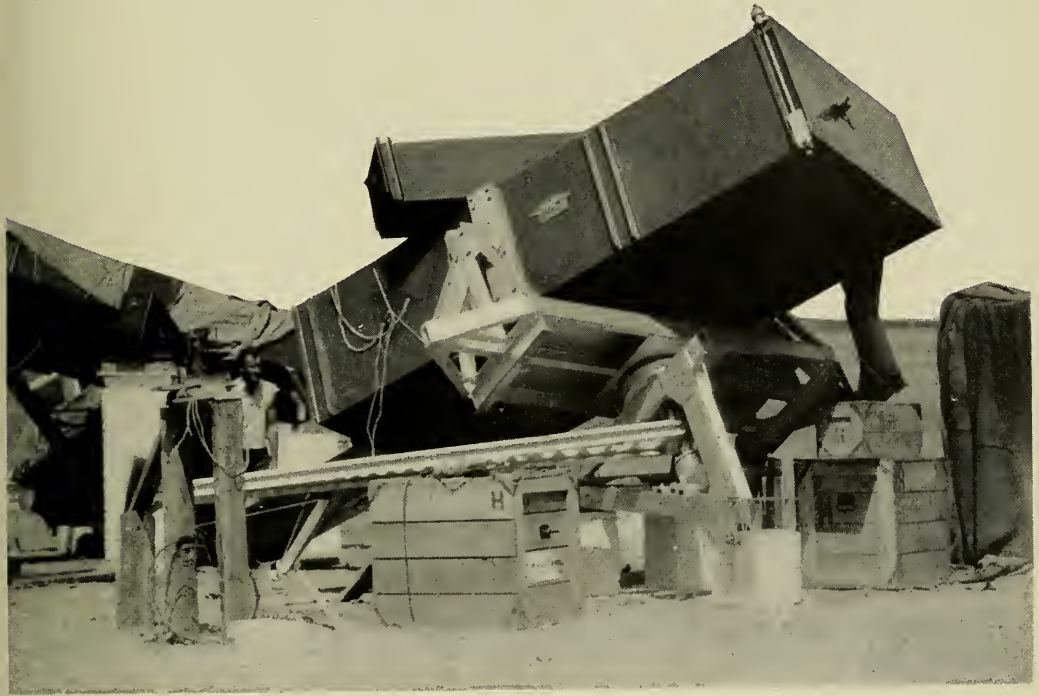
Eclipse next year

After three *Saros* periods have passed, that is, on July 22, 1990, as calculated by the eclipse wizard, Oppolzer, we shall have a total eclipse of the sun visible in almost exactly the same longitude, although farther north in latitude. While it may be a little early to plan expeditions to this one, astronomers are already looking forward to the total eclipse of next year—June 8, 1937—the path of totality spanning almost the entire breadth of the Pacific Ocean and ending in Peru. This eclipse, which will last seven minutes and four seconds, will be unusual in that the period of totality will be very nearly the longest possible.

The Eclipse in Kazakhstan

The first publication of photographs taken by Dr. Clyde Fisher of scenes in and about the camp in Asiatic Russia where the Harvard-

M. I. T. and the leading Soviet expeditions studied the most recent total eclipse of the sun



(Above) The "Snow-plow," a multiple spectrograph of the Harvard College Observatory, a most efficient instrument used in determining the composition of the sun and the state of its elements

*(Below, left) A last-minute conference with the leaders: Dr. B. P. Gerasimovich, Dr. Clyde Fisher, and Dr. Donald H. Menzel
(Below, right) Dr. Wallace Brode of Ohio State University photographing the flash-spectrum, the spectrograph covered with a tent*





(Above) Professor Eugene Perepelkin and associate with the fine horizontal telescope of the Pulkovo Observatory. Above the larger instrument a small Zeiss refracting telescope,

also used by the Soviet Expedition, can be seen. The Russian Government showed considerable interest in the eclipse. News-reels taken at the camp were shown all over the country

(Below) Professor M. Navashin, of the University of Moscow, and Dr. Clyde Fisher examining a reflecting telescope made by the former. The photograph of the corona on page 209 was secured with this home-made instrument

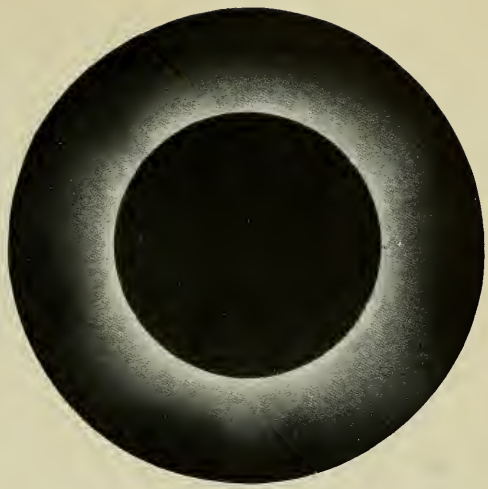
(Below) Dr. Irvine C. Gardner, of the Bureau of Standards, setting up his telescope with which he made color-photographs of the eclipse





Harvard College Observatory Photo

(Above) The famous "diamond-ring" effect, here shown an instant before the moon has completely covered the sun



(Above) Photograph by Professor M. Navashin of the inner corona together with unusually high solar prominences which were visible when the moon moved completely between us and the sun



(Above) The Eclipse-camp, showing from left to right, photographic laboratory, radio-shack, "Quadruped" (multiple spectrograph), "Snow-

plow" (multiple spectrograph) telescope used by Miss Swope, spectrograph used by Doctor Brode, and Doctor Gardner's telescope

(Right) Two little maids from school: Mordvin Russian girls in national costume. Note the heavy "put-ties"



(Below) Russian couple en voiture. Their horse resembles the Mongolian wild horse



(Above) Mordvin mother and child

(Below) Water supply and lumber are provided by time-honored methods



(Above) Russian peasant coating her house with a layer of adobe, a sort of stucco similar to that used by our own Pueblo Indians of the American Southwest



(Left) Clyde Fisher showing his Akeley camera to the leader of the Poulkovo Expedition

(Above, center) Miss Henrietta Swope on camel-back chatting with Professor B. P. Gerasimovich



Through India

A JOURNEY IN PICTURES BY MR. AND MRS. F. TRUBEE DAVISON

Mr. and Mrs. F. Trubee Davison recently returned from an expedition to India and Nepal for the American Museum of Natural History. This was made possible through the courtesy and assistance of Mr. Arthur S. Fernay, Trustee of the Museum. Mr. and Mrs. Davison made the trip from Italy and return by airplane over the Imperial Airways System. The route goes across the Mediterranean to Alexandria, then east through Palestine to Bagdad, south along the west coast of the

Persian Gulf, and then east again along the southern coast of Persia to India. Collections for the Museum were made in the United Provinces through the kindness of Mr. Donald Stewart, Forest Officer, and also with the able assistance of Major James E. Corbett; in Nepal through the kindness of His Highness, the Maharajah, and His Excellency, the British Minister, Lt.-Col. F. M. Bailey, C. I. E.; while in Mysore and Madras Ralph Morris assisted Mr. and Mrs. Davison



(Above) Mrs. Davison with a tigress which she shot for the Museum's collection. The tigress was crossing a stream and sank upon

being struck. Here the animal is shown as it was being dragged from the river by the natives

A memorial service for King George V in the jungle. While the Davisons were in the interior, word of the King's death was received over a battery radio set. Captain Ibbotson, the

District Commissioner, arranged the memorial service shown below, and can be seen with his back to the camera, flanked by the local Hindu priest and the Mohammedan priest

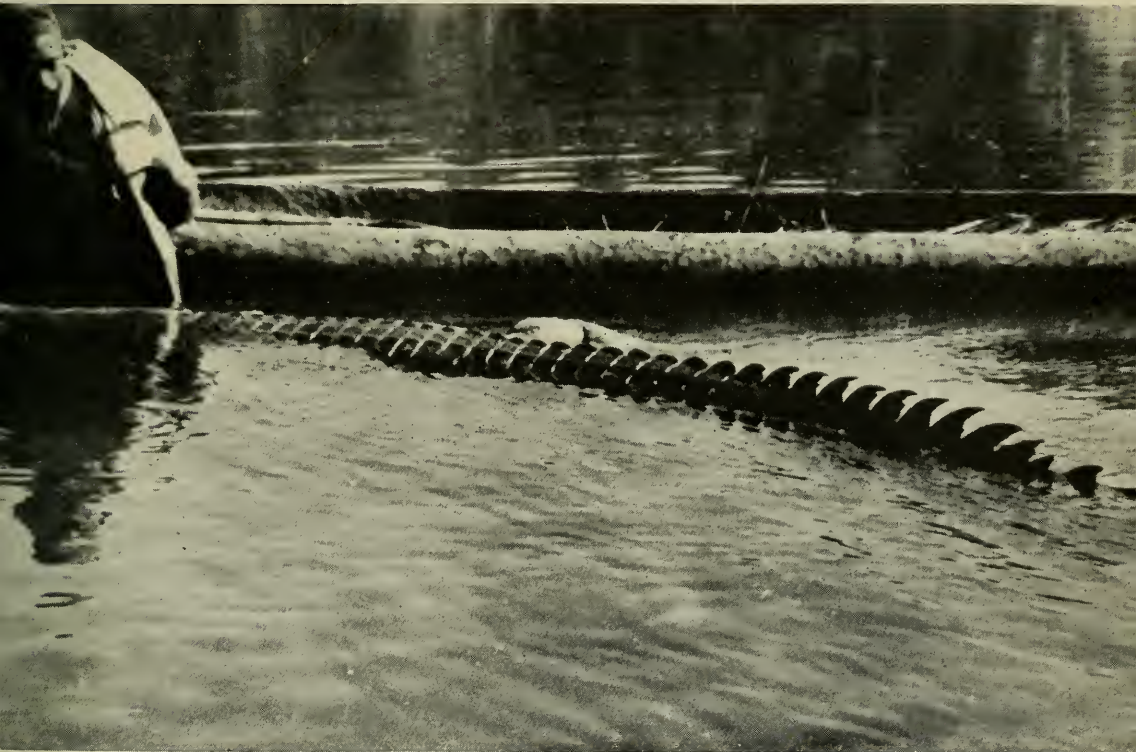


The cutting of timber in this region is under close supervision of the Government Forest officers. The picture at the right shows one of the natives engaged in the work



(Above) The bungalow of one of the forest officers in Kaladhunga, at which the party was staying

A crocodile shot by Mrs. Davison on the Gunduk River, while operating from the camp of the British Minister in the Nepal Terai on the Gunduk River



Weighing a very large tiger shot by Mrs. Davison. The Department of Mammalogy at the Museum is most anxious to have accurate weights of tigers, very few having been recorded. The means of weighing this one were rather primitive but accurate, the tiger being

slung in a cradle at one end of a beam and balanced on the other by rocks, which were later weighed by a small government lead of known weight. The tiger measured 10 ft. 2 in. over the curves and weighed 525 pounds, allowing for a five pound loss of blood



Transportation on the Gunduk River. Both poles and paddles were used to propel the craft, consisting of two dugout canoes lashed together





(Above) The outdoor dining room at Colonel Bailey's camp. Left to right: Lt.-Col. Bailey, Lt.-Col. Stevenson, Mr. Davison



Major dredging operations in the bed of the Gunduk River. For irrigation purposes, it was decided to change the course of the river, and the enormous task was carried on entirely by human hands



The high point of the expedition in human interest was a two-day trip across two mountain ranges, which happened to coincide with an enormous Hindu pilgrimage to a series of sacred temples on one of the sacred rivers. Every conceivable type of Hindu was repre-

sented, from the highest noble to the lowest diseased beggar, including many old men and women whose ambition it was to die with their feet in the sacred water. One method of travel was to be transported in a dandy on the backs of coolies



A striking demonstration of religious zeal: masses of Hindus thronging toward a common goal. The pilgrims came from hundreds of miles in every direction and endured severe hardships during their journey

Over the entire journey, the crowds making the pilgrimage were thick, some on foot, occasionally some on native ponies, others being carried on the back of a friend or relative, like the man in the photograph at the bottom of the page

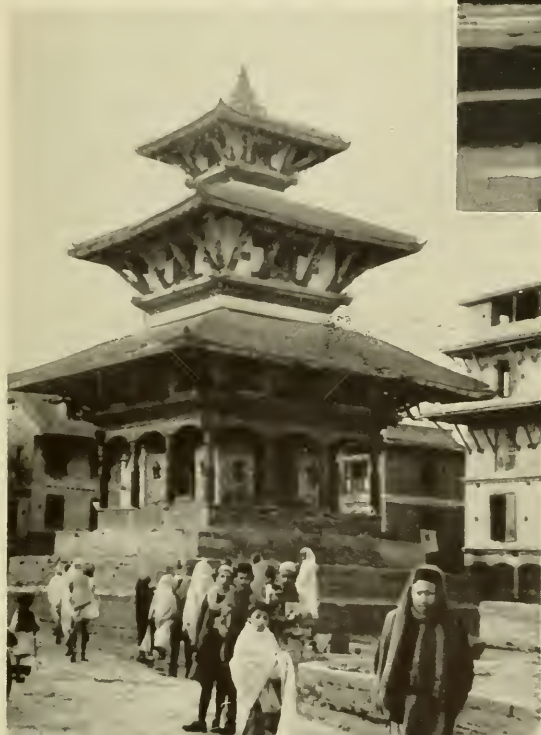




At the end of the pilgrimage, hundreds of steps led up to a famous Buddhist Temple



(Above) A lama from Lhasa, Tibet, who had been making the journey for over a year, the whole distance being covered by crawling on his hands, protected by large wooden gloves, dragging his feet to his hands and repeating the process



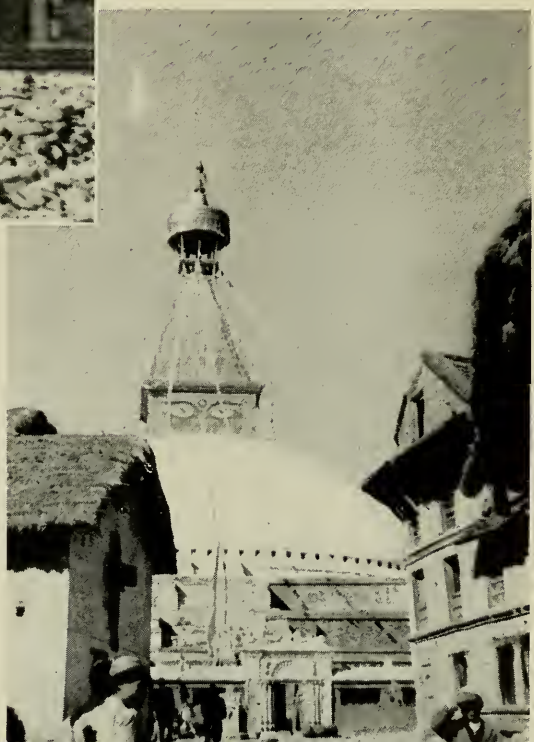
(Left) A Hindu temple

The tower of the temple, showing the eyes of Buddha which forever follow his disciples



(Left) A temple partially destroyed by a recent earthquake

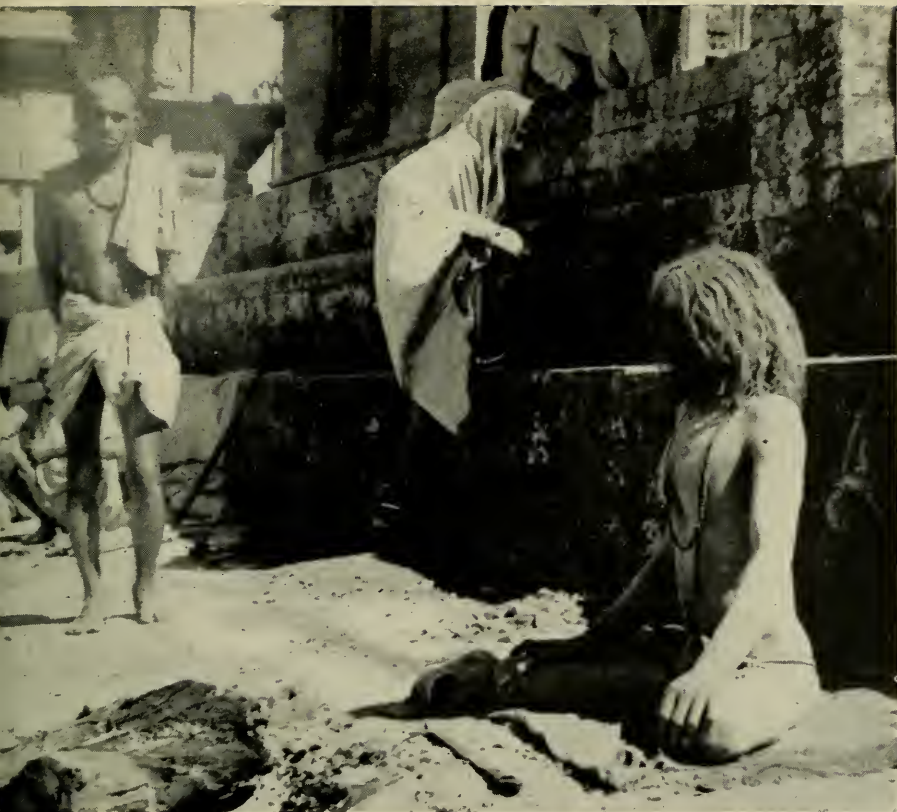
(Below) Buddhist temple





(Above) Pilgrims making puja (idol worship) within the temple walls. (Below) The actual temples sought by the pilgrims, on the shore of the sacred river





(Above) A typical Hindu Sadhu or priest in a trance

(Below) An automobile being carried over the mountain range on the backs of a hundred coolies

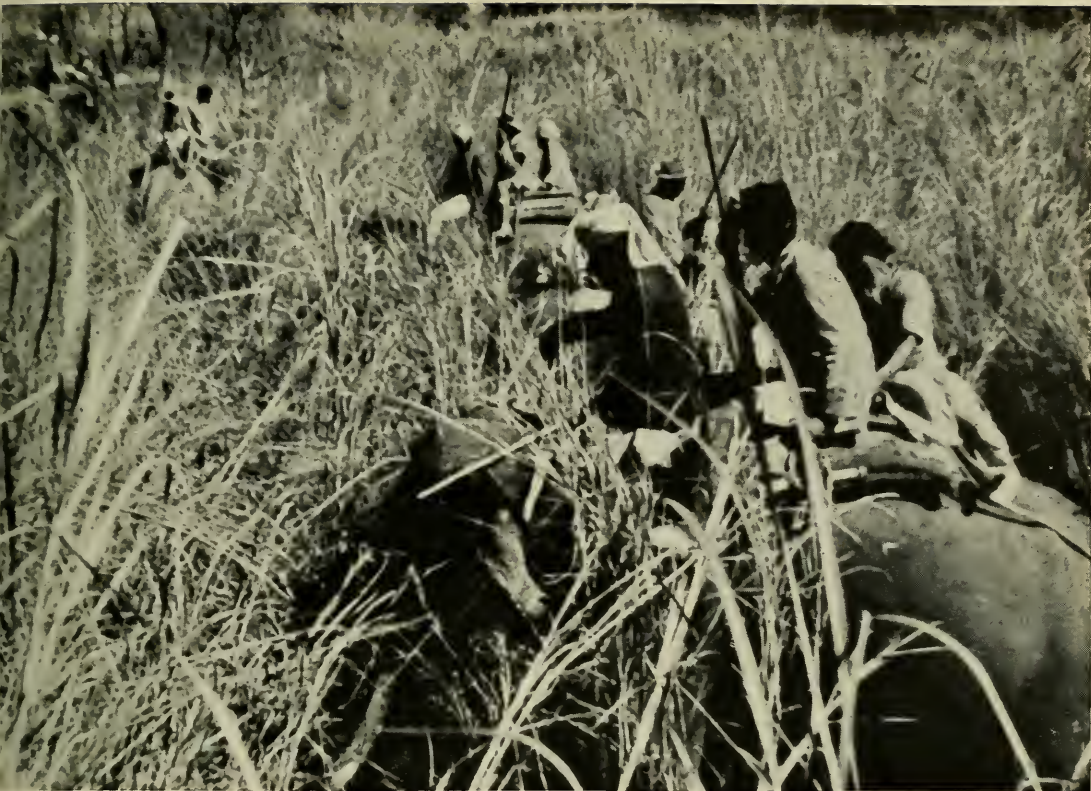




A roadside Hindu shrine in the Nepal Terai



In Mysore, a breakdown in transportation necessitates the use of oxen



Tiger hunting in the Nepal Terai is permitted only by the Maharajah; and when his season is finished, the British Minister is invited to shoot, with guests approved by the Maharajah. The tiger, when located, is surrounded with a ring of elephants, and then driven out of the

jungle circle by natives on the back of a big bull elephant. The shooting, while not dangerous, is difficult. The tiger is almost always charging and is only visible for a few seconds, and the elephants are generally stampeding. The picture above shows the ring being formed



At left, the ringing elephants are crossing the river; below, they are resting and cooling off



The party enters the range of the gaur, a large dark-colored wild ox, otherwise known as the saladang. A scene typical of Mysore and Madras



(Left) A very large gaur obtained by Mrs. Davison for the Museum

(Below) A native with his head entirely shaved except for a few strands by which he hopes to be pulled up into heaven



*Two native women in perda,
whose faces and eyes must
never be seen except by their
own husband*



*(Below) An old Model-T
Ford occupied by another lady
in perda*





*(Above) Entrance to the Maharajah's Palace
in Mysore, a very modern and beautiful city*



*The walled town of
Koweit, in Arabia*



*An Arabian village
built in swampland:
a photograph taken on
the return flight*

Cutting the Jonker Diamond

A rare event in diamond history—upon a light tap of the cleaver's mallet hung the destiny of the largest and finest uncut diamond in the world

By LAZARE KAPLAN

WHEN I was offered the opportunity of cutting the largest uncut diamond in the world, one might suppose that I would reach for it with eagerness. But since boyhood I had spent my life as an independent diamond merchant and craftsman, and I was loath to relinquish that independence and make my every professional movement answerable to another. The time element, too, had to be considered. Could I afford to devote my unflagging attention to another's interest? Would I be neglecting my own business?

Risks

There are as many facets to the diamond business as there are to the stones themselves. To be sure, there was a personal consideration that influenced me. I wanted my son, Leo, to share the experience of cutting and finishing the second largest diamond in the world. But to understand thoroughly my mixed feelings about the proposed undertaking, you should know the risks involved.

It is a common saying that Lloyd's will insure anything. But, while there were no difficulties in insuring the gem against the risks of an ocean crossing, they would not insure the cutting of the Jonker Diamond. The St. Paul Fire and Marine Insurance Company, which underwrote a \$1,000,000 policy, were content to have the diamond travel by ordinary registered mail, just as you might send your watch back to the factory to be repaired. But we could not insure the cutting. It is the only case to my knowledge where Lloyd's refused to insure something. Their refusal is indicative of the dangers.

The great moment in the life of a large diamond, therefore, is the instant when the cleaver's hammer strikes the wedge. In diamond cleaving there is no middle ground. It is either done perfectly or the diamond is ruined. Diamonds have grain like wood but offer far more complex problems, and to misjudge the grain is disastrous. In the case of the Jonker Diamond, beyond the usual anxiety that would surround a stone of such unprecedented quality, I was in the difficult position of disagreeing with the unanimous opinion of the European experts on how the diamond could be cleaved.

The damage which a small error in cleaving would do was beyond reckoning, for the peerless quality and extraordinary size of this stone made it the most important diamond extant. I had to think also of the prestige of the American diamond cutting profession, as well as my own reputation, for it was by all odds the largest stone that had ever come to this country for cutting.

Glamour

From the earliest times diamonds have stirred the imagination of men and women the world over. Wars have been fought over them, and wars have been left unfought because of their influence. Kings and emperors have worn them to accentuate their own power, and scientists have studied them in an attempt to fathom their mystery. Pliny, in his *Natural History*, described them as "the most costly of human possessions." The Greeks admired them because of their resistance to fire, because they were *unconquerable*, and so gave them the name *Adamas*. So elusive are they that strange stories have been circulated about them. Some

believed that, though both hammer and anvil would be shattered in any attempt to crush them, if they were "macerated in the fresh blood of a he-goat" they might "with some difficulty be split by a hammer." Others believed that the magnet lost its power when in contact with a diamond, that the diamond "also destroys the effect of poisons, and cures insanity."

The glamour of diamonds was born in my blood. At an age when other children were playing with toys, I was learning about diamonds from my father and uncle in Antwerp, the famous gem center. At 22 I was at the head of an important cutting plant there. Diamonds have always held for me the thrill of adventure.

Nearly half a pound

Those of you who may have seen the Jonker Diamond when it was on exhibition at the American Museum of Natural History (the only occasion on which the public were given an opportunity to view it), remember an irregular frosted crystal about $2\frac{3}{4}$ inches long and $1\frac{1}{2}$ inches wide. Its weight was 726 carats or nearly half a pound Troy. In the rough the Jonker has all the characteristics of a typical river diamond: the little spots of iron oxide and sand, often forced into the open cracks of the stone by the action of the water; the frosted gray coat; the form and composition; and finally the soft blue fire. This diamond, unlike other large ones, had not a single internal flaw, only a few "skin" flaws.

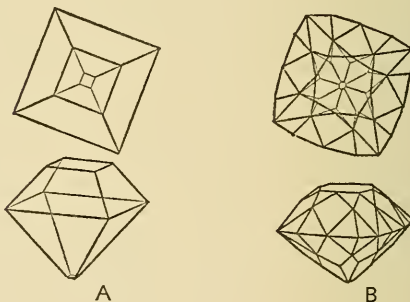
The story of its discovery was like a tale out of a book. Jacobus Jonker was an over-worked prospector and farmer of 62, who had persevered for 18 years, always on the brink of fortune, but always poor. He had reached the depths of despondency over his future, when his luck turned. There had been a heavy rain storm and when it died down a native was put to work on bucket gravel, some of which had been washed up by the storm. He found a dirt-crusting stone about the size of a hen's egg. When he rubbed it clean his eyes nearly popped out of their sockets. He had found World Diamond Number One. That night the treasure was put in a stocking and tied around Mrs. Jonker's neck. She went to bed but did not sleep, and the men kept guard at the door of the poor hut with loaded revolvers.

Jonker sold the rough gem to the Diamond Syndicate for a reputed \$350,000. It went to London and was of course examined by the leading experts. Even before the diamond reached London the well-known American gem dealer, Mr. Harry Winston, cabled for an option and himself reached London soon after the diamond. He spent a month studying the stone comparing it with the Cullinan, the Kohinoor, and the other famous gems. Upon purchasing it he was confronted with the question of who should cut it. The foreign experts presented their plans with models of the separate gems which they thought could be taken from it.

The finding of the correct plane of cleavage presented an intricate problem. Usually, in cleaving a diamond, the planes of cleavage are obvious at first sight, the real problem being to discover the exact position of any chance imperfection. In the Jonker, however, the problem was the reverse, the location of the grain presenting the greater perplexity.

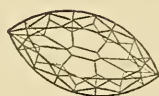
Much publicity had been given to the large flat surface of the Jonker Diamond, and all the European cutters took it for granted that

SOME TYPES OF CUTTING



A. The earliest form of diamond cutting

B. The Brazilian cut brilliant or Old Mine cut, in vogue during the last century



C. The American cut brilliant



this large surface represented one of the planes of cleavage, and outlined the cutting of the diamond in accordance with this theory. But in all ways this gem is a freak of Nature and to follow their plan would have ruined the stone.

Mr. Winston had, a short while before, entrusted me with the cutting of the Pohl Diamond. This was an extremely imperfect gem of 286 carats in the rough, full of flaws. I contrived to cut it into 15 stones, all of which were perfect except one and even that one sold for \$50,000. This achievement in cutting was one reason why Mr. Winston thought of me in connection with the Jonker Diamond. He knew further that I had trained a corps of craftsmen whose skill is not surpassed anywhere in the world.

At no time in my experience had I been confronted with such a tremendous challenge as when Harry Winston submitted the Jonker Diamond to me. Everything about this astounding stone was extraordinary. It would seem that Nature herself had entered into the conspiracy to guard this priceless treasure from the covetous possession of man. First she

drew a film over the stone's brilliance disguising its surface with a common frosted glass exterior. Again, its very size was disarming. David, when he faced Goliath, might have picked it up and thrown it away in disgust as being too large to fit his sling. Another clever device was for Nature to leave it, not where other diamonds lay, but in the chance back-yard of a humble farmer.

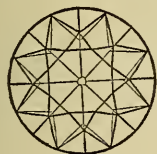
A disastrous error averted

I studied the diamond for months. A small ledge on the diamond was what opened my eyes to the mistake that the European experts had all made. It took strong self-assurance to follow my conviction. So elusive was this beauty that it was a year before I was sure of its grain. Once I was almost on the verge of delivering the blow with the mallet when I noticed a microscopic bend in a slight surface crack or gletz. This threw all my calculations off at the crucial moment. There was one certain spot on the surface of the Jonker that indicated the correct plans for cleaving. Then somewhat as a naturalist reconstructs a dinosaur from a few scattered bones, I laboriously reconstructed the crystallization of the diamond and thus determined exactly all the planes along which to cleave. Finally when I was sure, to the fraction of a millimeter, I knew that the elusive mystery of the Jonker Diamond lay at the mercy of a light tap of the mallet.

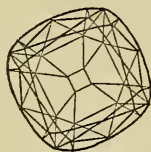
Of all the great diamonds in the history of the world, the Jonker is only the second to be cleaved, the first being the Cullinan. And one who has not seen this operation, which combines the difficulties of an engineering feat with those of a delicate surgical operation, cannot appreciate the strain to which it subjects the operator. When Joseph Asscher cleaved the Cullinan Diamond he so feared that a mistake might be too great a shock to his weak heart and cause him to drop dead, that he had a doctor and two nurses in attendance ready to revive him. When he delivered the stroke successfully he sank into a chair with a gasp of relief, was treated by the doctor, and spent three months in a hospital suffering from a nervous breakdown.

No ordinary instruments would accommodate the great Jonker for this operation and I constructed special ones. I found only one

*Courtesy of Herbert P. Whitlock
Abridged from "The Story of the Gems"*



C

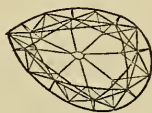


D



D. The square brilliant, of which the Cullinan IV is an example

E. Marquise cut diamond



F. The pendant cut, of which the No. III Cullinan diamond is an example



F

small place where I could make a groove. One tiny slip would spoil the groove and compel me to abandon my whole plan for cleaving. You may well imagine that in this initial step, my son, Leo, and I exercised the greatest care. The groove was scratched deeper and deeper, with a series of sharper and sharper diamond edges, so as to produce a clean V-shaped groove. Then a steel blade was inserted which is not unlike a carving knife except that its edge instead of being sharp is square. This gives the maximum spreading force of a wedge. A specially constructed, counterbalanced mallet was held above it, and my son and I knew that the light tap that would be given in the next second would ring down the curtain on complete failure or complete success. The blow was struck and the diamond fell apart in my hand exactly as we had planned.

I must admit that it was a glorious feeling of superiority that came over me when I had found that I could make this magnificent jewel, of the hardest and most enduring material on earth, obey my command.

Invisible saw teeth

Cleaving is only the first operation in the cutting up of a large stone. While it can be accomplished only in the direction of the grain, the second operation of sawing can be accomplished only across the grain. Whereas the first cleavage took a fraction of a second, the first single sawing required five weeks of continuous work.

The saw is a disc of phosphor bronze about four inches in diameter and between .005 and .002 of an inch thick. None of the standard diamond sawing machines was large enough to accommodate the Jonker, and we had to rebuild one. The edge of the saw is not sharp, but is cut square and is covered with a mixture of diamond dust and olive oil. The diamond dust works into the phosphor bronze and acts as the cutting surface. On a damp day the cutting effect is greatly reduced and at times becomes negligible, and the operator then uses an ordinary electric heater to reduce the atmospheric humidity. When the weather is cold and dry and the windows have to be kept shut, the diamond dust gets into the air and is bad for the health of the operator. At the end of the day he will feel heavy and

his cheeks will burn. To avoid this he periodically removes the excess dust from the blade with a tiny mop of cloth. Though the diamond is one of the clearest of known substances, the dust which comes from sawing it is black like lead-pencil powder.

After being sawed the separate pieces are cut and polished. For this they are set in a metal foundation and held against the surface of a revolving disc. This operation puts the facets on the gem. Great accuracy in faceting the diamond is all-important to its beauty. The facets should be arranged so that as much as possible of the light entering the stone is reflected through the top. This mirror-like function of the facets is due to the high index of refraction of the diamond, and it is only with masterly polishing that optimum brilliancy is obtained. The same composition of olive oil and diamond dust does the work. But the wheels, of porous steel, are manufactured especially by a secret process that has been passed down for generations in one family in Belgium.

The destiny of the Jonker

The Jonker Diamond will make 12 separate gems, the largest of which will be approximately 170 carats. Of the original 726 carats the final aggregate will total only a little over 400, approximately 300 carats having gone into dust.

One might think it a mistake to break up a stone of such unprecedented quality; but it will be far more valuable in separate pieces than in one. In former times there was a market for single stones of great size among kings, queens, and princes, but the day of crown jewels has virtually passed. What will be the future story of the Jonker Diamond no one can say. We can only hope that its career will not be attended by the bloodshed and sorrow that has surrounded so many great jewels, and that it will enhance the beauty of beautiful women for many centuries. So far, its discovery has brought happiness to many, and it has brought no sadness into the world. To have taken some part in its story gives a feeling of participation in a great adventure. Humbly I am glad that my adventure with the Jonker has been the means of adding something to the general knowledge about diamonds.

Cutting the Jonker Diamond



An unusual series of photographs published

for the first time in NATURAL HISTORY

When a humble diamond prospector discovered the Jonker Diamond he held in his hand:

*The largest uncut diamond in the world
A flawless stone, finer in quality than any of
the larger ones in existence
A diamond approximately as large as a*

hen's egg and weighing nearly half a pound.

*An unimpressive lump of crystal with a
common frosted glass exterior, a stone which
"David, when he faced Goliath, might have
thrown away as too large to fit his sling"*

Because of the grain, diamond cleaving must be done perfectly or the gem is ruined. At left, Lazare Kaplan is shown marking the lines of cleavage on the Jonker Diamond after months of study. His plan disagreed with the unanimous decision of the European experts on the direction of the grain



Pough Photos

(Right) A knifelike piece of another diamond cuts a groove for the insertion of a wedge at the point where the diamond is to be cleaved

(Below) The blunt wedge is inserted in the groove

Pough Photo

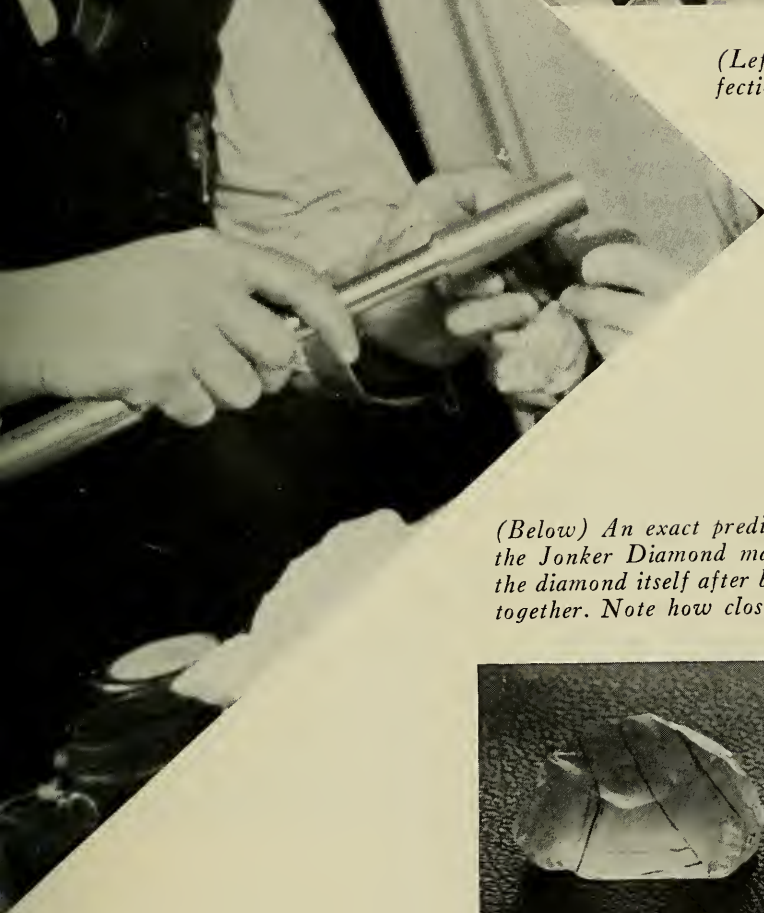




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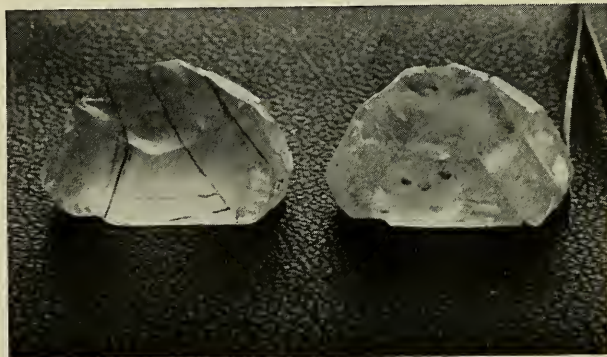
(Left) The blow is struck: perfection or destruction?

(Above) The diamond falls apart exactly as planned: Lazare Kaplan and his son, Leo, after a breathless moment, examine the perfect cleave



(Below) An exact prediction. At left, a facsimile of the Jonker Diamond marked for cleaving; at right, the diamond itself after being cleaved twice and fitted together. Note how closely the lines agree

Pough Photo



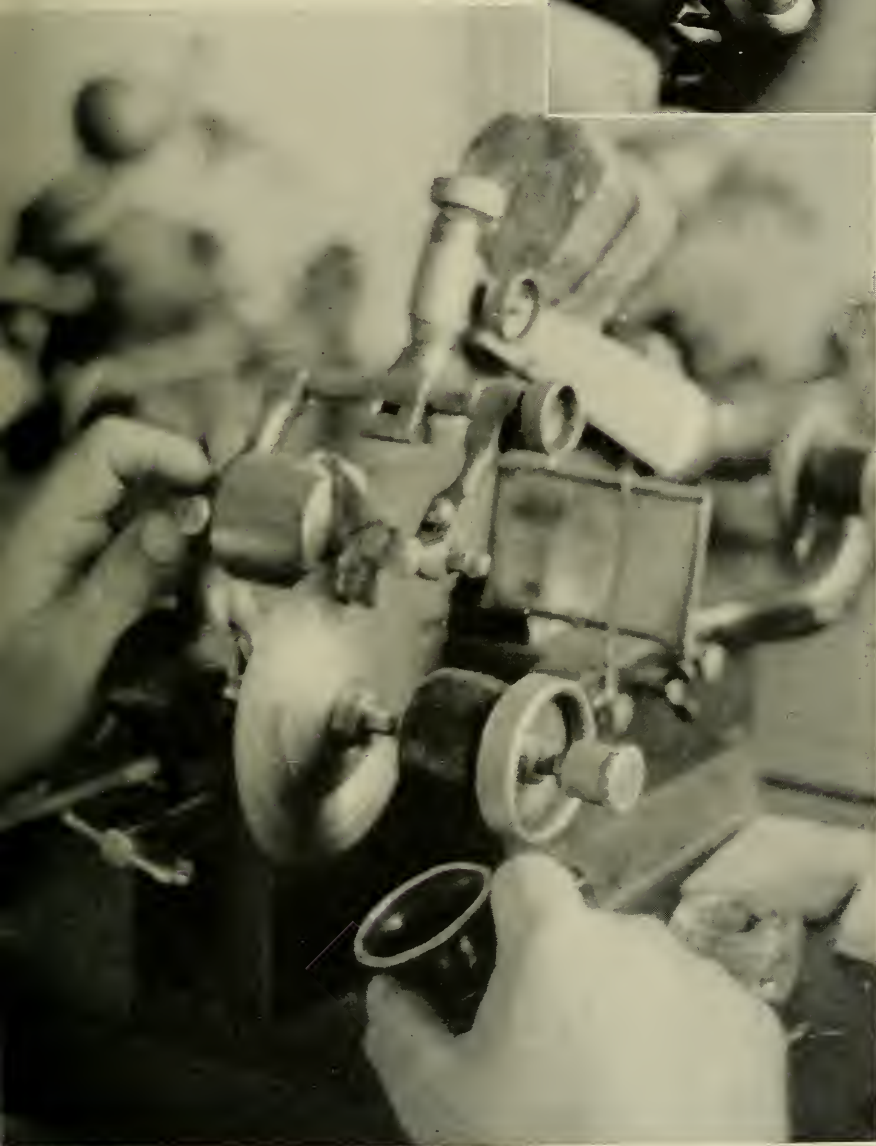
After cleaving comes sawing. Unlike cleaving, sawing has to be done across the grain

Below, the operator is shown applying diamond dust and olive oil to the edge of the phosphor bronze disk which serves as the blade



(Left) A special clamp to hold the great diamond during sawing. No ordinary clamp was large enough

(Right) If the diamond dust is breathed in the air it produces a feeling of heaviness and causes the cheeks to burn. Therefore the operator removes the excess dust from the wheel with a small mop of cloth, as shown in the photograph at the right



Pough Photo

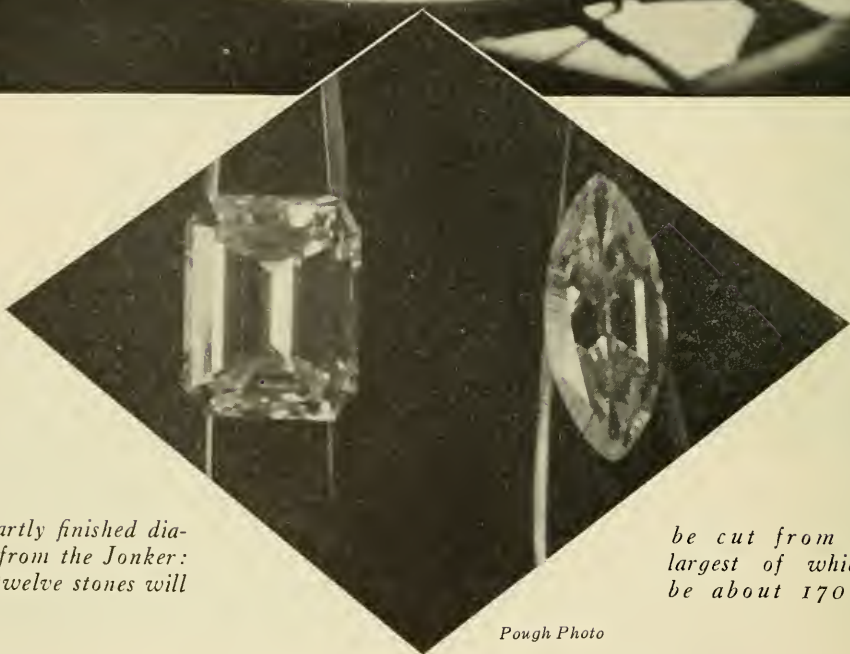
(Above) An unusual sawing. The blade is slowly working its way up toward a saw-cut previously made from the right-hand edge. The saw blade does not do the sawing; it is the diamond dust imbedded in its blunt edge

On damp days the sawing goes very slowly. Unlike the cleaving operation, which is over in a fraction of a second, the first single sawing on the Jonker required five weeks of continuous work



The final step: grinding and polishing. The diamond is frequently examined under a lens and measured with small gauges to see that its facets are set at the right angle. The facets are placed so as to reflect the light back and forth and enhance the brilliance of the gem

The diamond is ground on a high-speed wheel coated with diamond dust and olive oil (see center photograph). These wheels, of porous steel, are made exclusively by one family in Belgium, in which the secret has been passed down from generation to generation



Two partly finished diamonds from the Jonker: in all, twelve stones will

be cut from it, the largest of which will be about 170 carats

Pough Photo

Fun with Sharks

When an indefatigable sportsman girds himself for battle with the most hated creatures of the sea there is excitement a plenty

By COLONEL HUGH D. WISE

U. S. Army, Retired

I HAD had great fun in Cuba, in Hawaii and in the Philippines with sharks, so when I came home to Virginia, in the early nineteen hundreds, I persisted in the sport of my boyhood there and usually kept most of the boats at my father's place, at Cape Charles, smeared with evil smelling shark blood. I was still using hand-lines, harpoons and barrels, but had never attempted to catch big sharks on rod and reel.

Sharks on rod and reel!

Throughout my fishing career, I had been pestered by sharks—Dog Sharks, Bonnetheads, Hammerheads, Mackerel Sharks, Sand Sharks, and Dusksies. Little sharks and big sharks had snapped my lines, kinked my rods and slashed fine fish which I was bringing up; but never, until one day at the Virginia Capes, had I realized what sport there might be in catching these pests on ethical tackle. "Sharks! Sport-fish on rod and reel! You're crazy!" would have been my reaction to such an idea.

That day, I had a fine forty-pound drum-fish right up for the gaff when a glint of grey in a swirl of foam flashed at the boatside and when it disappeared so did half of my drum.

"George," said I to the boatman, "If these darned things are after a game, let's play with 'em." Making a leader of a handy piece of bale wire and putting on a big hook, I baited it with the half drum left me and tossed out.

Immediately the bait was seized and the reel shrieked. Novice though I then was in shark taxonomy, I recognized the sharp snout, robust streamline body and keel-like side ridges

of a Mackerel Shark, probably the fastest and gamest of our Atlantic species.

Realizing that my channel-bass tackle was not equal to a fight from an anchored sloop such as this promised to be, and knowing that we could not up-anchor before the fish reached the end of my twelve strand line, I jumped into the dory's bow and George, following me, threw off the painter and seized the oars.

All reel drags were squeezed hard down and I was pressing the thumb-pad except when I had to slip line to spare it more than test strain; yet half of the three hundred yards were out and the line hummed like a telegraph wire before we had the boat under way. "Faster! Faster! Follow him! Follow him!" I urged the sweating George who was then doing his very best, but the reel spindle was already showing in spots when we began to hold our own.

After two miles of this chase, during which I had alternately slipped and recovered line, we began to gain a little on the fish and we were obliquing off to try to get a sideways pull to turn him.

Seventeen circles

We were then out beyond the point where John Smith landed, and we knew no more than he when he set out where we were headed for. With numb hands and aching back I held hard while George set an example for a Henley champion. In another mile, we were almost abreast of the tiring shark who now began to yield to my "pumping" and was turning. A little more and we had him circling the boat, a hundred yards off, so we on an inner circle could keep abreast of him. Around and around, seventeen times, he went, his sharp fin and crescent flukes showing above his white

surge, and then off he went in another straight-away rush which took out most of my laboriously recovered line and scorched the thumb-pad. Then, suddenly ceasing his rush, he sounded to the bottom and we rowed up directly over him. In spite of hard pumping he could not be budged. He might as well have been the anchor until I chanced to remember an old trick.

Taking a bait "jimmy-crab," I locked his claws to encircle my line and let him slide down. Hardly had his wiggling legs landed on the shark's nose when up came the shark and off he went like a dog with a can to his tail. He was simply wild. Never had I seen such speed in a fish! It was one of the few times I had seen a shark leap clear of the water but up he went, once, twice, three times, like a tarpon, and, by these gyrations, he threw the crab. Then he settled down to more circling on the surface but he never again sounded. The "jimmy-crab" had cured him of that!

No living creature could expend such energy without tiring; so, in two hours, he was thoroughly exhausted. I was tired, too, and George slumped over his oars. Finally, the double line came up, followed by the leader and George led the shark to the gunwale, now only waving his tail but still vicious enough to grind his lance-like teeth on the boat's planking. The gaff struck into the vital gills but, made for a seventy-five pound channel bass, its crook straightened under the weight of this big fish who in his frantic threshing deluged us with bloody spray and sank to be pumped up again. This time we got a slip-knot over his tail and hauled him aboard. A beautiful specimen of Mackerel Shark weighing more than two hundred pounds. What a fish! I have caught many bigger sharks but never a gamer one!

"George," I shouted, "what do you think of it?"

"Well, suh," he replied, mopping his face with a scrub-rag, "I thinks I prefers drum-fishin."

The beginning of a new sport

Perhaps the sweat in George's eyes had kept him from seeing the possibilities in the new sport which I had discovered at our very door, and in which we could indulge when tuna and other big fish were not accessible. I saw those possibilities, however, and I began experimenting with tackle and bait, and hunt-

ing for the places where sharks were most likely to be found. The hydrographic charts on my father's study walls were no longer used by me for navigation but for locating the tide runs where sharks would be looking for prey.

While I was probably the first to take up the sport of angling for sharks in that vicinity, I was by no means the first shark fisherman in the Chesapeake and we must give the credit for that to John Smith who came there some years ago and who nearly met his death by trying to spear a selachian with his rapier, not ethical tackle, by the way. The place where he got a stingray spike through his thigh is still known as Stingaree Point.

All along our Atlantic Coast, offshore and in bays, there is good shark-fishing and it is surprising how few anglers avail themselves of it. Do they think that it is as uncertain and as expensive as swordfishing or do they say, as I used to say: "Sharks!—You're crazy!"

From Cape Charles northward, a string of low islands (Fisherman's, Smith's, Cobb's, etc.), stretching between the open sea and the mainland, makes a narrow sound—the "River," it is locally called—which opens into the ocean through inlets between the islands.

Ideal fishing ground

The comparatively quiet water of the "River," bordered by wide marshes with deep tide channels, teems with marine life and is, therefore, an ideal feeding ground for small and medium-sized sharks, while larger ones hang around outside the inlets waiting for rejects from seines and traps or for other food to drift out with the ebb tide.

In some degree, therefore, an angler may choose whether, by staying inside, he will have several fights with sharks of from fifty to a hundred and fifty pounds, or whether he will go outside and try for a big fellow which might weigh a thousand.

Inside, the angler will probably find that an ordinary fishing boat and regular light tuna tackle will suffice, but outside, he should be equipped for heavy deep-sea fishing.

His boat, large enough for considerable sea, must be fast enough to follow the rushes of the fish and handy enough to maneuver with them.

The boatman, no less than the angler, must understand the game and from his wheel, in

sight of the rodman, he must conform the movements of the boat to those of the fish.

I like the swivel-chair in the cockpit, aft of midships, from which position the fish can be fought always over the side rather than over pitching bow or whirling propeller; and, throughout the struggle, the boat should be kept broadside on to the fish, not only so the line may not foul deck-house, flagstaff and tiller but also because the boat will be in better position to conform to the movements of the fish.

Fisher in harness

The angler should be in a swivel-chair so he may swing to face the fish and unless it is below the gunwale, he should be strapped in because a hundred-pound pull might easily slide him overboard.

On the chair there should be a pivoting rod-seat, for the angler could not hold the rod in his hands and, with a belt-rest, his solar-plexus will get a terrific mauling. He must have also a shoulder harness because neither hands nor arms could withstand the strain of hours of tussle with a big shark. Such a fight may last hours and if the angler does not feel equal to that, he had better stay "inside" and content himself with the smaller sharks.

In my observation the greatest danger of losing the fish comes soon after the strike, before the boat is under way, or near the end of the fight, when he is being brought in for the iron.

The shark may hit the bait with a savage lunge, but except with the White or the Mackerel Shark, there is more likely to be a preliminary tugging. When this comes, slip the line a little, and, when he takes the hook, strike! And strike hard! He has a tough and leathery mouth.

Galvanized by the sting of the hook and infuriated by the check, away he goes in a wild straightaway. You can't stop him, so lie back in your harness, tighten down your drags, and put all safe pressure on the thumbpad! Meantime, you are cussing the boatman to get under way and follow.

The boat takes a course parallel to that of the fish and about fifty yards away from it and you, by vigorous pumping, are trying to turn him and to recover some of the line he took out with his first rush.

After a mile or so, the shark and the boat,

the one retarded by the pull of your line, and the other helped by it, may be almost abreast in the race and you may have turned him and started him circling. It is your job now to keep him under constant tension, pulling his head toward the center of the circle of which your line is the radius while the boat follows on a smaller inside circle.

If you have in half of your line, to insure against another rush, there will be no immediate advantage in getting back more of it. On the contrary, it is better to keep the fish circling on a long radius to tire him out while you, lying back in your harness, save your strength for the fight to come.

There will be more rushes and more circling and, sooner or later, the shark will probably sound to the bottom and try to rub out the hook. Whether or not he could do this, he must not be allowed to lie there and rest. Your back may ache, your arms may be numb, your hands may burn, but you must "pump him up."

Sometimes a shark will suddenly cease pulling and will dash full speed toward the boat and past it, faster than you can reel in line. There is not much danger that he will throw the hook, but there is real danger that he may snap the line if he comes sharply to the end of the slack. You must throw off the free-spool lever and take on the strain gradually with the thumb-pad.

The dart is driven home

Toward the end, his rushes become shorter, his circling smaller, and his soundings less mulish. He is tired and so are you! Finally, you get the double line up and then comes the steel cable. The boatman takes it and leads the shark to the boatside; the dart is poised and driven home. The lanyard whirls from the bucket. You drop back in the chair and light your pipe. What remains is the boatman's job!

C. Russell Bull, whom I call Charley, lives when not out in his boat, at Townsend, near the point of Cape Charles, Virginia. He is a fisherman and he would rather fish than eat, which is fortunate; for, having to eat, he makes his pleasure provide for his necessity. He had regarded nets, traps, and lines solely as means of capturing edible and marketable fish until I came along and proselytized him to the shark game and so diverted considerable

of his time from more useful employment.

At first he knew as little as I about shark-fishing, which was indeed not much, but he was an apt follower of an enthusiastic leader and together, he at the wheel, and I in the chair, we learned until we became an efficiently working pair of "nuts" and a menace to the asterospondyli, which is a "high hat" name for sharks.

Charley's boat, a twenty-foot navy "barge," is seaworthy, well-engined, reasonably fast and handy, and it immediately caught my eye as just the boat for the sport. Its after third is an open cockpit in which I put my chair, only a few feet from the wheel, to let the angler be within easy communication with the boatman who in turn is within arm's length of the engine controls.

Forward of the cockpit is a little cabin in which are two bunks, a hanging table and cooking paraphernalia. All is simple and neat, but there is no pretense of the yacht. It is just a little fishing boat on which two people can live comfortably and, if necessary, two more can live uncomfortably, in hammocks.

Freedom on the wave

Charley is not only a good fisherman and a competent pilot, but he is also an excellent cook. When we sail we stock up with staples, take plenty of eggs, butter, milk, fruit and vegetables. The waters teem with fish, oysters and soft crabs. On our trips we have no schedule and we are not slaves to the clock. In fact, the clock is of minor concern, for it is the tide which regulates our lives. When it is right for fishing, we fish; when it is not right for fishing, we eat and sleep. Meals are prepared when more important matters do not demand attention. If weather be good, we stay outside; if it be bad we run in for shelter and stay there until it is better.

There is always infinite variety in the sea and in the waters opening upon it—"Age cannot wither nor custom stale her infinite variety"—and, for the man who loves them, there can be no monotony. With good company, good air, good food, good rest, and good sport, knocking around in a boat can be just about an ideal existence.

We are not always after sharks and for a change, or to rest tired muscles, we may turn toward drumfish, bluefish, weakfish, or any

other variety that will take our bait. Hence the assortment of rods and tackle which clutters the little cabin.

We usually get plenty of these fish, but on one of our trips we utterly failed, and it was a shark which saved us from being "skunked." Specifically it was a specimen of the Great White Shark. This fish must be credited or discredited with being the true "Man-eater," for it is against him that naturalists have most conclusively sustained the murder charge. Linnaeus even indicted him as being the fish which swallowed Jonah, exonerating the whale as being incapable of taking a man down his gullet, though we now know that certain whales could do this.

We had been fishing for a week and Sunday, my last day, with conditions perfect, found us two hours before sunset with but two fish—a pair of small weakfish.

We were then trolling for drum and had just come into Little Inlet, one of my favorite shark grounds, but it was six weeks too early for sharks and with a ten-ounce rod and No. 12 line, I was prepared for nothing heavier than drum. We were rolling along on the swell, hoping vainly for one of them to strike, when I spied a big fin.

"Shark! Stop the boat!" I shouted, and Charley throttled the engine.

"You don't expect to get him on that outfit, do you?"

But I was already rigging a wire leader and a big hook onto my little line.

"We'll try!"

Whee-w-wee-w!

The tide drifted us back, the bait, one of my little weakfish, trailing along beneath the surface fifty yards astern. When it reached the place where I had seen the fin, there came along the line the characteristic tug of a shark. He had firm hold of the bait but had not taken the hook so I slipped him a few feet of line, and Bang! he took the hook and I struck. "Whee-w-wee-w!" went the reel, and I seemed to be fast to a speed boat. "Follow him!" and I put on all safe drag. The little 4/0 reel seemed to howl with pain and I expected the rod to snap at any moment, for I was giving them more than reasonable strain. The boat finally got up full speed and we were following the fish, but he had out all but ten yards of my line when he ceased to gain

on us. Then, with the resistance I could give him, we began to gain, and in the next two miles I recovered half of my three hundred yards of line.

Steering off on a course parallel to that of the fish, in another mile we were abreast of him and I had him yielding and beginning to turn. He circled nicely a few times, but then, changing his mind, he went off into another rush of several miles before I could turn him again. When the circling recommended, the tide was carrying us out rapidly, so we went spiralling towards Spain.

"Are you prepared to serve breakfast on this ship?" I asked Charley. "I see no probability of catching this minnow tonight."

"Not unless you and the fish will give me a chance to cook it," he replied, and the shark, unconcerned about our breakfast, spiralled out further to sea.

Land was almost hull-down when he sounded and lay still, and Charley, taking advantage of this armistice, slipped the harness onto me. Hardly was I thus geared when the shark woke up and went off into another long and furious rush which, however, was his swan song for I "put on the heat" and he grew rapidly weaker. The harness was now giving me relief and I saw to it that the shark got none.

His speed a mystery

Throughout the struggle this shark had puzzled me for he was faster than any species I knew, except the Mackerel Shark, but the fleeting glimpses I had had of a blunt nose and a massive body showed that he was not a "Mackerel." When finally he was brought alongside, his fins and fluke stiff, and his body motionless, Charley struck with the gaff but, stimulated by the pain, the shark wrenched the gaff from Charley's hands and went down for another half hour of struggle. Twice more was this repeated but when he came up the fourth time Charley, leaning over the gunwale, finished him with a butcher knife in the gills.

Now we had our first chance to recognize him. The dark spots on his pectorals, his olive ventrals, his ashy-brown back, white sides, caudal keels and triangular serrate teeth identified him as a small though beautiful specimen of the Great White Shark.

On the boat-side he measured nine feet and

two inches over all, and we estimated his weight as well over three hundred pounds. He had cost me a sprung rod and a damaged reel but he was worth it. His vitality had been amazing, but the fool fish had helped to catch himself, for it was his frantic rushes and hysterical circling which exhausted him. For long stretches he was on the surface with spray flying over his bow like that from an aquaplane. Nevertheless, it took two hours and forty-six minutes, from hook to gaff, to subdue him.

Perhaps I should be satisfied that he was a modest edition of this largest and most ferocious species of our North Atlantic, for the Great White Shark is said to attain a maximum length of more than forty feet.

Jersey waters

What was said of the Virginia Coast might almost as well apply to the entire Middle Atlantic Coast, and especially to the coast of New Jersey. There is a string of low islands and narrow sand strips standing off from the mainland as outposts against the onrush of the seas, and these separate from the ocean the almost continuous narrow sound which, in different places, we call by different names.

The water, too, has there the same gently rolling loveliness it has on the Chesapeake. There is a ripple, not a surge, to its movement and shadows from fleecy clouds, wafted by breezes laden with salt-marsh aroma, make myriad green tints on the surface. It is all so peacefully restful that even the gulls seem to dawdle in their flight. But through the inlets one bounds out onto the roaring blue ocean—What has all this to do with shark-fishing? Simply that the angler has his choice, as he had at Cape Charles. He may stay inside for little ones or he may go outside for big ones, but one of the uncertainties which go to make fishing interesting is that he may get the big one where he expected the little one, the little one where he expected the big one, or he may get neither.

It may be remembered that it was a Hammerhead on the Chesapeake which literally towed me into this shark-fishing game, but it is not that alone which is responsible for the thrill I always experience when fast to a Hammerhead. He is a wary suspicious fellow who is hard to outsmart and he has game-

fish qualities equalled by few other sharks.

Nature, always with a purpose in what she does, has given this fish his freakish head to be used for making his dives and loops, as ailerons are used on an airplane, and so erratic are his gyrations that once—I hesitate to tell it—a Hammerhead tied a knot in my line. I hasten to explain, however, it was a simple knot, not a bowline.

In contrast to other sharks, most of which have rather small, staring, amber eyes, the eyes of the Hammerhead, located in the outer edges of the vanes of his head, are large, dark, and bovine, but please do not imagine that I am trying to make out a case of gentleness for him for he is, as his blade-like teeth indicate, as savage as other sharks, and as mean a devil as any of them.

Fight with Hammerhead

The finest struggle I ever had with a Hammerhead was one day on a glassy sea ten miles off the New Jersey Coast when we spied a high sharp dorsal fin, "gaff topsail" sailors call it, cutting the surface half a mile astern and following straight in our wake. Slowing down our engine, I let out three hundred yards of line baited with a fair size bluefish. As the bait skittered along on the surface the Hammerhead overtook it, circled it and came on. There was really no disappointment in this because it was exactly what a man, familiar with this wary fish, would expect. We opened throttle, dragged the bait past the fin, and this time the shark dashed at it, splashed around it, showed great interest, but was still too timid to strike, so we slowed down, and then—Bang! He had it! On he came straight for us while I wound frantically. Fifty yards astern he seemed to associate us with his toothache; increasing speed, he swung wide around us, and I wound hard to take up the great bellying sag in the line. With the fish a hundred yards

to port, the line came straight. I threw off the free spindle lever, thumbed the pad, screwed down drags, struck hard to set the hook and then—what a performance!

A demon on the line

Straight towards us dashed the fish, whirling and pitching on the surface, barely clearing our bow. Then away he went—two hundred yards to the other side while the boatman, leaving his wheel, clambered atop the deck-house to clear the line. Like a flash the fish turned and was back again, just clearing the stern while John fended the looped line from the propeller with a boat hook and I struggled in vain to take in slack. Again and again this was repeated and then the Hammerhead changed his tactics to short dashes back and forth on the surface, and dives and loops beneath it and once, in spite of our backing and turning, he went across under the boat.

John got a lot of practice with his engine and rudder, my wrist ached from winding and my thumb burned from the hot pad before we finally got the fish to circling. After an hour of that, the big gaff hook drove into his gills and the fight was over. It had been like a tarpon-fight except that this demon was bigger and stronger than any tarpon, and he looped in the water instead of going into the air. Hammerheads are wary, fast, and game but I have never seen any fish put up a finer fight than this one did, from hook to gaff. I forgot to measure and weigh this shark so I can give only my estimate—9 feet, 250 pounds.

In next month's NATURAL HISTORY Colonel Wise will tell more of his thrilling experiences—but this time he will deal with the dreaded Tiger Shark in the waters off the Bahamas.

Fun with Sharks

(Below) The Thresher Shark. This excitable fish has a whip-like tail stretching the length of his head and body combined, a weapon with which he herds prey, and destroys nets



(Below) Whale Shark beached at Acapulco, Mexico: One of the largest fish of modern times and one of the most brilliantly colored of the usually drab Shark family. Bright yellow spots are centered in a checker-board of white and yellowish lines

*Photo by
C. T. Wilson*



(Left) Tiger Shark. The mention of his name sends cold chills through the natives of the Bahamas and West Indies where he abounds. He averages ten to twelve feet in length and is one of the most savage of his kind



(Right) The Tiger's Jaw: Naturalists have long claimed that a whale could not have swallowed Jonah, and Linnaeus has attributed the deed to a shark. Photo shows author Wise doubling for Jonah

(Below) Gaily colored youth: As the young Tiger Shark grows older, the small dark rings on his skin fuse into a fairly uniform greyish-brown

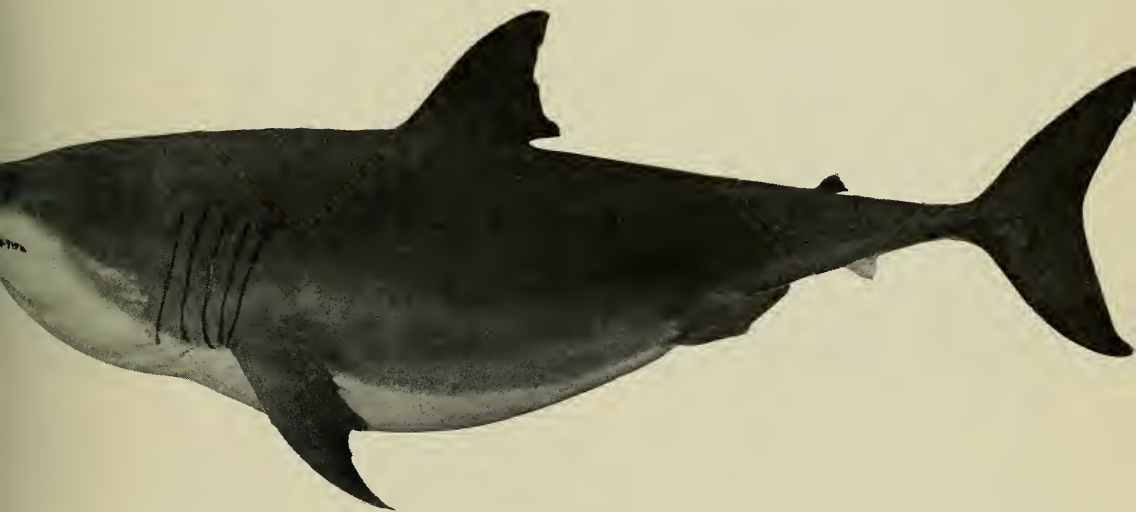




(Courtesy Capt. Lancaster)

(Above) No Mass Suicide here: A Viviparous Tigress, with litter born after her capture. It is fortunate the female is so prolific, for otherwise the cannibalistic tendencies of the older fish would result in racial suicide

(Below) The True Man-eater: The great White Shark against whom the murder charge has been most conclusively sustained. Essentially a rover, he is possessed of astonishing strength and vitality



(Right) Twelve and one-half foot Hammerhead with six foot man; Dr. E. W. Gudger holding one end of the freakish "hammer," Nature's equipment for making the tricky dives and loops that have literally tied knots in the fisherman's lines

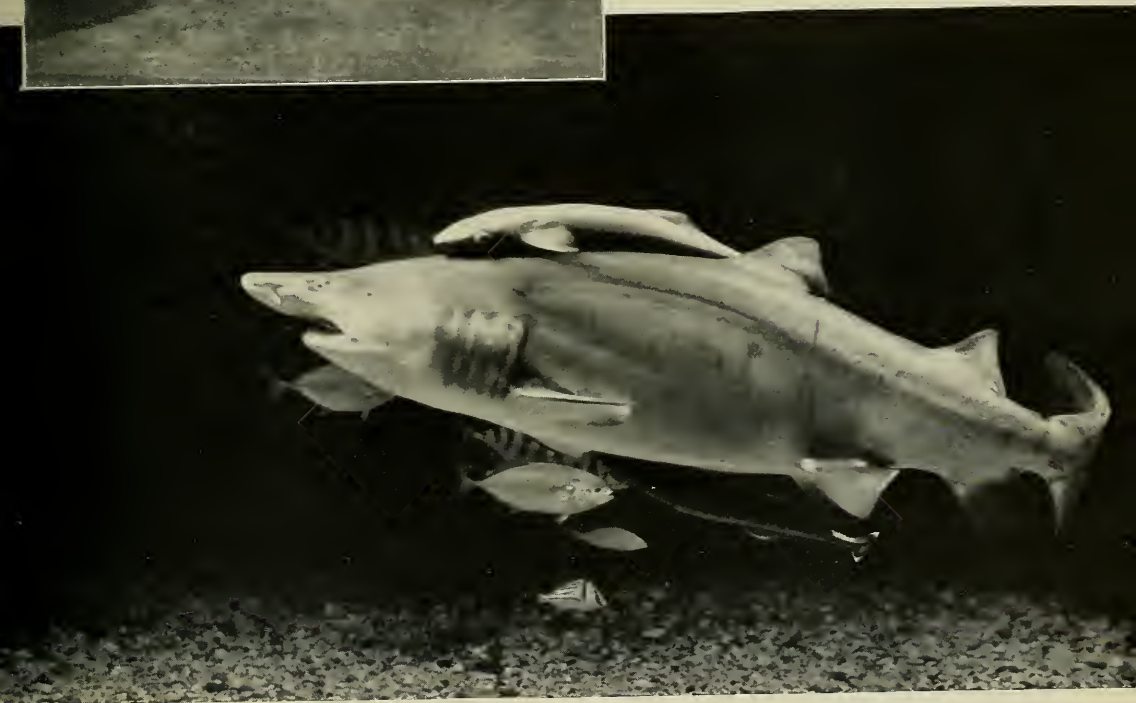
Courtesy E. W. Gudger



(Above) Rovers of the Deep: White Shark, Hammerhead Shark, Southern Ground Shark, Tiger Shark, Spot Fin Ground Shark, Sand Shark, Loggerhead Turtle. The latter is often attacked by sharks, especially the White and Tiger Sharks



(Left) Hideous: No creature of the sea is so gracefully lithe gliding through the water, but none is so terribly fearsome as he dashes at his prey



(Above) Shark carrying an underseas "Hitch-hiker": The remora, a fish that clings to the shark, snatching crumbs from his table. Fixing himself by a suction organ to the shark's body, he often travels far out in the ocean



Courtesy Worthen Paxton
 (Above) Nassau's native divers have no fear of sharks as they plunge for tourist coins. The monsters are downright afraid of any such commotion
 (Below) Worthy trophies: the shark has been overlooked as a big game fish. Both the novice and the seasoned sportsman will find a fit opponent

Courtesy Mondiale
Black Star



Worlds Underground

Nature's most sublime handiwork and the art of early man await the tourist who ventures into the earth

By ANNA MCNEIL

WE are all wanderers and explorers at heart, fascinated by the spell of the unknown, yearning to cast our daily routine aside like a garment, and to "take our pack and set out for the ways beyond." When the comforts and pleasures of home give place to the lure of distant scenes and attractions nothing is more enchanting than a cavern tour. Interest never slackens, for no two caverns are alike.

Perils of cave exploration

The men who first entered caverns braved the perils with inadequate light and equipment. A false step spelled injury or death. The sound of their own footsteps was terrifying; the dust stifling; the shadows full of menace. There was the constant fear that fragments of rock might become dislodged and block the exit; and always the possibility of a plunge into an underground stream. Modern inventions have now made all explored areas safe. Electrically operated elevators provide swift and easy descent. Electric lights remove all hazards. Experienced guides conduct sightseers so that one cannot get lost. There are no temperature changes for the thermometers in practically all caverns remain stationary at about 56 degrees F.

Howe Caverns, New York, are visited annually by 100,000 tourists. These caverns, an hour by automobile from the state capital, Albany, are in the fertile and picturesque Schoharie Valley, a short distance from an old stone fort in which the pioneers took refuge from the Indians, and which in a perfect state of

preservation is now used to house relics of these early families. The caverns, which geologists claim have been a million years forming, lie in beds of limestone nearly two hundred feet thick. One of the marvels is a winding way, 550 feet in length, the work of erosion, in which the turns are numerous and so abrupt that persons walking single file cannot see the individual directly ahead. There is a delightful boat tour on a limpid lake two hundred feet beneath the earth's surface.

From Howe Caverns the tour leads to the Shenandoah Valley in Virginia, one of earth's loveliest spots. The name is derived from an Indian appellation meaning "Daughter of the Stars." The valley begins at the confluence of the Potomac and Shenandoah rivers at Harpers Ferry and extends between the Blue Ridge and the Allegheny Mountains southward for nearly two hundred miles to the historic James. Its scenery is tranquil and charming. Beneath the floor of this peaceful valley lie the Shenandoah, Massanutten, Grand, Endless and Luray caverns and the famed Blue Grottoes. These have probably all been occupied by prehistoric man; have served as places of refuge during Indian uprisings, and have provided shelter for the soldiers of both armies during the war of 1861-65.

Nature's sculpturing

Some of the notable sights within this group are the Persian Palace, the Ball Room, the Cathedral, the Saracen's Tent, and the Hall of the Giants. There is a wedding scene with a bride in white, a bridegroom and attendants, all cunningly sculptured by natural processes. On the ceilings and along the walls are ani-

mals, flowers, trees, and replicas of familiar objects, all so realistic that the skeptical declare that they must be the work of man although they assuredly are not.

Since Calvin Coolidge summered in the Black Hills, the gorgeous scenery of this region has attracted throngs of visitors to the Dakotas. Crystal Cave in South Dakota can be reached by leaving the main highway between Rapid City and Sturgis, near the town of Piedmont, and following a road five miles in length through Elk Creek Canyon. This cave was found by hunters who followed a wounded mountain lion into an opening in the face of a cliff. They emerged into a high-ceilinged room covered with prism-shaped crystals which reflected the colors of the rainbow in the light of their pine torches. More than 1450 rooms in this cave have been opened.

A dome of diamonds

Jewel Cave, sixteen miles from Custer, South Dakota, on Highway No. 36, gives the effect of the whole interior being studded with diamonds. A chamber called the White House has a dome-shaped ceiling, architecturally perfect, covered with glittering crystals.

Missouri has a group of caves which rank with the largest and most interesting. Onondaga Cave, near Leasburg, eighty-five miles southwest of St. Louis, has been opened for three and one-half miles. Part of the tour is made by boat. This is an onyx cave and some of the formations are nowhere surpassed. The Lily Rooms are characterized by water-lily replicas, the lily pads of onyx seemingly afloat in glistening pools. Embedded in the floor of this cave are two human skeletons which in the slow course of the ages have become thickly encrusted with onyx.

Marvel Cave, five miles west of state highway No. 43 and fifteen miles southeast of Reed Springs, Missouri, is in the "Shepherd of the Hills" country. It was the haunt of many animal species during the Pleistocene era, and contains a Dead Animal Chamber in which are the remains of thousands of creatures, some long since extinct. Naturalists assert that this was the chosen mausoleum of wild animals of past ages.

Many volumes have been written describing the miracles in stone of Mammoth Cave, Kentucky, discovered by a bear-hunter in

1809, and the first cavern of importance to be opened to the public.

Mammoth Cave has been explored for 150 miles and probably covers a very large area not yet known. It has become part of the vast National Park system which the United States Government has organized to preserve natural conditions and historic and scientific features unimpaired, for all time. Thousands of acres have already been acquired and the purchase will eventually include Kentucky's entire cave region.

Four tours have been arranged, the longest of which occupies more than eight hours. The crowning glory of the cave is the Star Chamber. The ceiling is heavily coated with a jet black mineral deposit pierced with glittering crystals. The guides carry acetylene lamps. As the rays of light are directed upward, the crystals sparkle brilliantly, and the illusion of the heavens in the pure severity of a winter night is complete.

The ceiling of the Snowball Room is covered with globes of gypsum as if a snowball fight had been waged by elfin sprites.

In the Crystalline Gardens there is a two-mile walk over a path which seems to have been paved with crushed jewels. Almost every flower known is reproduced in virgin white with foliage of curling, acanthus-like gypsum. In contrast to this enchanting sight there is a formation of great length and awesomeness which resembles the bed of an ancient river with five cities, demolished by Time, along its desolate banks.

Mighty voices

Echo River, 360 feet below ground, is a vast resonator. The slightest sound is magnified a thousand times, gathering sweetness as it rolls away through the dim corridors of stone, until lost in unknown depths. Standing at a certain point the listener feels the very earth tremble with the vibrations of his voice.

Radio experts have conducted experiments in Mammoth Cave which prove that radio waves of the frequency used for broadcasting pass readily through 300 feet of solid rock.

Five hours are required to visit the points of interest in Colossal Cavern, near Mammoth Cave. This is the sweets shop of the elves, for there are numerous saccharine incrustations so candy-like in shape that whole cartloads of confections appear to have been spilled there.

A giant lizard motionless on the brink of a stream proves on close inspection to be a bronze-colored mass of flint.

New Entrance Cave has a Frozen Niagara of onyx which is a startling counterpart of the famous cataract and is considered by many persons to be the most beautiful of any cave formation.

Great Onyx Cave is known far and wide for its exquisite gypsum "feathers" and for its Hour-Glass.

The interior of Great Salts Cave is composed of chemically pure Epsom salts. Every movement of a person walking and the heat from the lights being carried, dislodge countless particles which fall like snow.

Journeying westward, Arizona has a Colossal Cave, 26 miles from Tucson in the Rincon Mountains, which has been explored for days by experienced men who have found no end to it. There is a legend, probably well-founded, that early Indian tribes used this cave as a passageway to the San Pedro canyon at the farther side of the Rincon range.

A natural mausoleum

Gypsum Cave near Las Vegas, Nevada, is one of the best-known of the smaller caves from its association of man with extinct animals. It has yielded bones, claws, and even the coarse, yellowish hair of the ground sloth, the bones of the native horse, and two species of American camels, besides quantities of bird and small-animal bones.

Man's occupancy has been found in the form of charcoal, burnt sticks, flint dart-points, and crude wooden dart shafts decorated with painted designs. These have been uncovered in the same deposits as the animal remains, or still lower. The Southwest Museum of Los Angeles is conducting further explorations within the cave in the hope that subsequent discoveries will settle the question whether man inhabited the continent thirty thousand and more years ago, or whether the Pleistocene animals survived until a more recent period than has been assigned to them.

The Carlsbad Caverns in southeastern New Mexico are believed to honeycomb the entire Guadalupe Mountain range. The secret of their existence might never have been revealed had it not been for millions of bats which nightly, rose from a vent in the mountain side,

appearing at a distance like smoke from a chimney. This sight attracted the attention of Jim White, a cowboy, who located the spot after a difficult climb and spent three days within the cavern, lighting his way with candles. When he told of the wonders he had seen his friends complimented him on his lively imagination. The story finally reached a government employe who put credence in it and investigated for himself. The deposit of bat guano which had accumulated at the entrance for centuries, sold for hundreds of thousands of dollars.

The Carlsbad caverns have now been made accessible and attract the equivalent of a large city's population, each year. They offer the most massive formations known. One chamber is half a mile long and 349 feet high.

Records of early man

There are many caves throughout the United States that are little known to the public but of importance because of prehistoric finds. An expedition of ten men recently searched Utah's "Bad Lands" for dinosaur remains. In a canyon in the Grand Gulch district they came upon a cave with many undecipherable pictographs upon its walls. A curious design formed in a group of grooves hewn into the rock was disclosed in another cave. A score of ears of corn, a bunch of sticks, a boll of cotton and a boomerang were among other discoveries and were pronounced by museum authorities to be possibly ten thousand years old.

Food cakes resembling the modern doughnut have been found in caves near Kenton, Oklahoma, together with crude domestic implements. The original doughnut makers passed into oblivion centuries ago and not even legend persists to throw light on their identity.

Human remains in a mummified state have been found in Kentucky caverns with meagre evidence of their times and customs. These people lighted the gloomy recesses with fagots bound together with strips of bark, dipped in bear fat. Their utensils were gourds, shown by many broken pieces. Corncobs, watermelon and sunflower seeds, and tobacco believed to be the oldest in existence, have been brought out for study. Fragments of moccasins and of textiles crumbled into dust, however, at the moment of exposure to the outside air.

The world's first miners delved for salt, easily obtained with primitive tools. Rushing underground rivers long since dry, have hollowed out vast caverns in western salt mines and these have yielded stone hammers with wooden handles, a carved club of a type developed thousands of years ago, sandals made of yucca fibre and many human bones.

The lore of Indians, Mexicans and Spaniards is a jumble of romancing against a background of possible fact. Amazing tales are still told of hidden treasure brought in ancient times from Mexico and Peru and guarded by members of an Indian esoteric order who inflict terrible punishment upon white men if by accident or design they locate the caves in which this fabulous wealth is secreted.

A number of cave sites in northeastern Nevada are soon to be excavated under direction of the Bureau of American Ethnology. It is hoped that discoveries will be made which will throw some light on the culture of the mysterious Mound Builders. It is not now known if Aztecs or other tribes from Central and South America actually migrated northward and came in physical contact with the Mound Builders, or if the latter absorbed certain points in common indirectly, possibly from trade with a people in association with the Aztecs.

Cavern explorations on other continents have yielded rich returns. An Italian expedition searching for traces of prehistoric man in southern Africa, reported the finding of an iron foundry buried six feet deep in an enormous cavern, in strata of the Paleolithic age. Iron still is smelted by primitive people with the methods employed four thousand years ago.

Superstitions

In ancient Europe caves were supposed to be the abode of sibyls, nymphs, fairies, dragons and evil spirits. No man dared descend into their depths for fear of what might happen to him when his intrusion was discovered. In the early centuries, the practitioners of black magic asserted that a unicorn's tooth was the most potent of charms. Superstitious man's desire to possess such a talisman outweighed his dread of the unknown. He knew that wild animals had their dens in caves and reasoned that a unicorn's tooth would be found there if anywhere. He ventured within and returned

without the charm but with no tale of curse or disaster or encounter with eerie inhabitants. Thus, caves came to be freely explored. Tens of thousands of animal bones, the accumulation of eons, were revealed. In the light of later knowledge these have been classified. The reindeer, grizzly bear, woolly rhinoceros, cave lion, brown bear, bison, cave bear, wolf, mammoth, the great urus, elk, and hyena once roamed the continent in such a remote period that climatic conditions were wholly unlike those of today.

Ancient art galleries

The caverns of France contain rock pictures estimated to have been made many thousands of years ago. Prehistoric man drew them with sharp pieces of flint. The crude outlines are still visible. Since practically all of these drawings represent animals, it is believed that they had some connection with weird rites practiced by cave men to insure success in the hunt.

One of the largest of these ancient art galleries was discovered by a small boy who burrowed through a hole in the ground on his father's farm, which attracted him because of its unusual size. He had heard his elders talk about the drawings on cavern walls, and boy-like was eager to make such a find for himself. A few feet from the entrance he was able to stand upright and he groped his way through a long corridor untrodden for scores of centuries and finally emerged into a huge chamber. In the dim light he discerned that the walls were literally covered with animal likenesses and with the imprint of men's hands, the work of Cro-Magnon artists.

The boy's experience did more to foster cave exploration in France than anything that had previously occurred.

Cro-Magnon artists flourished in Spain, likewise.

Many hitherto undiscovered caves will probably be revealed to airplane explorers, who, flying low, can detect entrances that are hidden from persons on the ground. This will be especially true of caverns on mountain sides and in canyon walls.

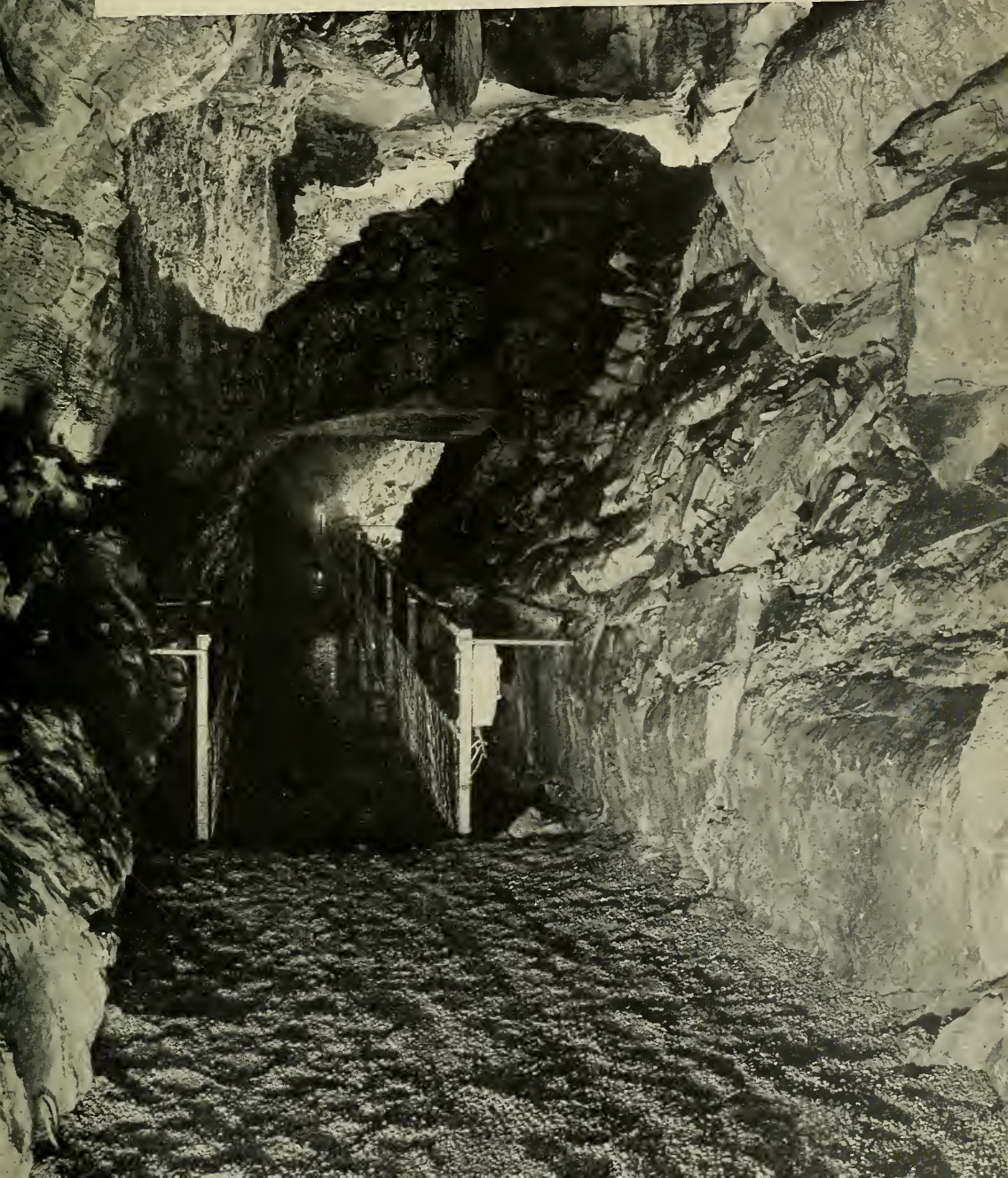
Perhaps our own United States holds in its million-year-old caverns, many secrets of the infancy of the human race. It is certain that the richest and most startling archaeological finds are yet to be made.

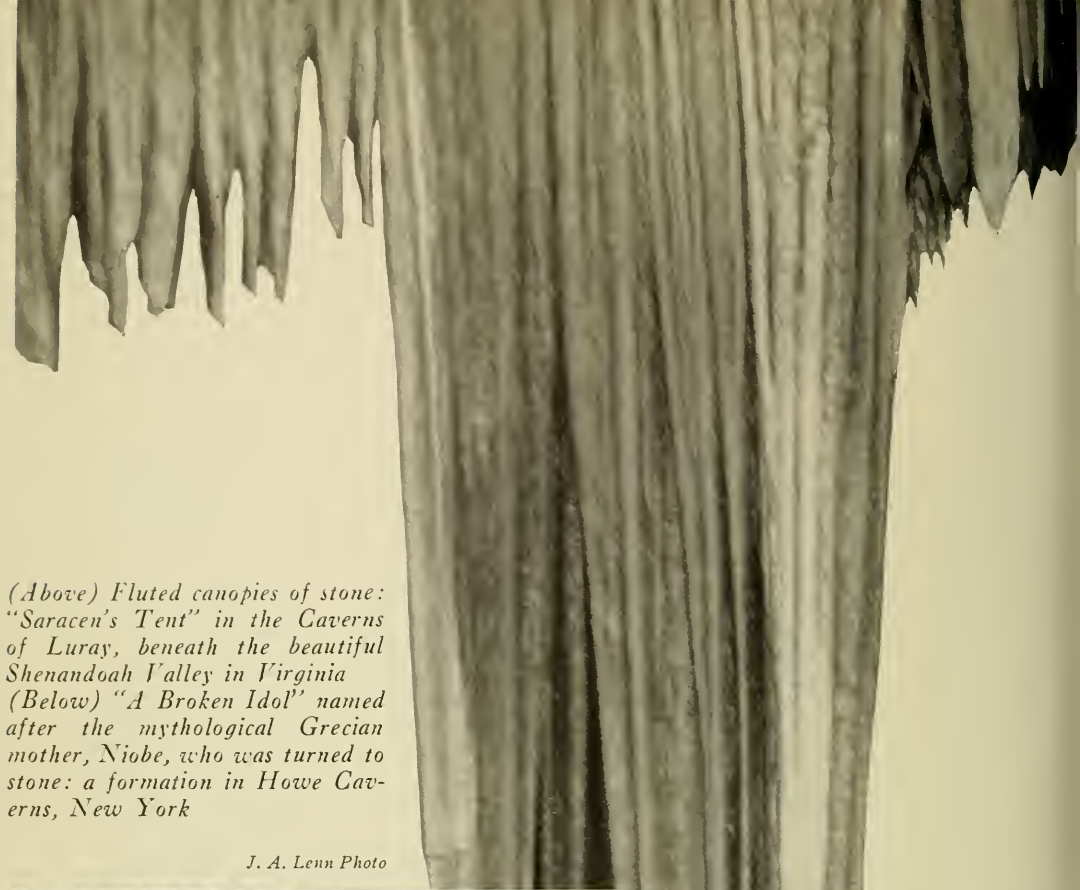
Worlds Underground

Tourists fail to realize the accessibility of underground wonders in many states. Gone are the dangers of former cave exploration. Electric lights, elevators and expert guides facilitate fascinating explorations into some of the earlier chapters in the history of the earth and man

This photograph shows a passage in Howe Caverns, New York, a cave visited annually by 100,000 persons

(J. A. Lenn Photo)



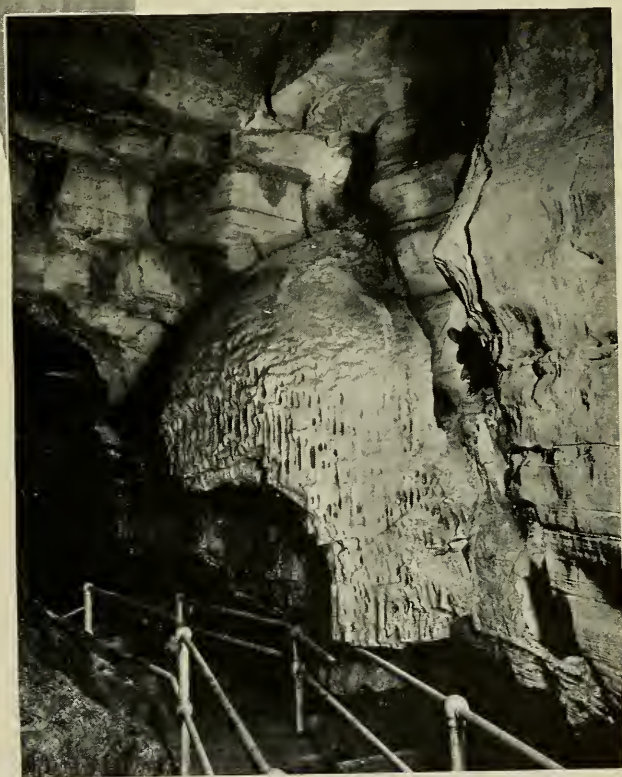


*(Above) Fluted canopies of stone:
"Saracen's Tent" in the Caverns
of Luray, beneath the beautiful
Shenandoah Valley in Virginia
(Below) "A Broken Idol" named
after the mythological Grecian
mother, Niobe, who was turned to
stone: a formation in Howe Cav-
erns, New York*

J. A. Lenn Photo



*Gene
Elect
Ph*



(Right) The Bishop's Pulpit, Howe Caverns, New York: one of many strange examples of Nature's underground handiwork that can be seen within an hour's drive of Albany

(J. A. Lenn Photo)

(Below) A fantastic chaos of pillars and curtains greets the visitor at the entrance to the Giant's Hall in the Caverns of Luray, Virginia
(Insert) Side Saddle Pit, Mammoth Cave, Kentucky. Since its discovery in 1809, Mam-

moth Cave has been explored for 150 miles. The visitor has a choice of four tours, the longest of which requires more than eight hours

(Photo: Louisville and Nashville R. R. from E. J. Hall)





General Electric Photo

(Insert above) The Kissing Bridge, Howe Caverns. The Winding Way in which this feature occurs, is 550 feet long and twists so

abruptly that one cannot see the persons walking immediately in front of him
(J. A. Lenn Photo)



© Field Museum of Natural History

(Above) The famous frieze of horses in the Cap-Blanc rock shelter in southwestern France. Ice Age hunters who carved these figures fought the large cave-bears for the shelter of caves, and produced the finest naturalistic art of prehistoric times

(Below) One of our Cro-Magnon ancestors of about 30,000 years ago engaged in artistic endeavor. In the man's right hand is a hollow bone tube through which he blows powdered red ochre around the outlines of his hand to form an imprint on the wall

Exhibit reproduced by P. Gatier, under the direction of Abbé Breuil. Courtesy of Field Museum of Natural History ©



(Below) A Neanderthal Family of perhaps 50,000 years ago represented at the entrance to the Devil's Tower rock-shelter at Gibraltar. Neanderthal man is believed to have been the first to seize a woman and protect her from

animals and other men. He lacked tools for sewing clothing, yet he sometimes endured the climatic conditions of the modern Eskimo. Fires glowing at the mouth of his cave barred animals and cold



Courtesy of Field Museum of Natural History ©

(Below) Members of the Cro-Magnon race which drove the more primitive Neanderthal people out of Europe: a painting by Charles R. Knight for the American Museum, showing

early artists at work on the famous Procession of Mammoths in the cave of Font-de-Gaume, Dordogne, France. Light was provided by stone lamps burning tallow



Creatures of

Glimpses of animals which have never been seen even by their own kind: a remarkable series of cave portraits by Charles E. Mohr. Born into eternal night, some of the creatures in these pictures may never have seen light until the photographer's flash startled them in their haunts, if indeed they have eyes to see. All are native to eastern United States



*(Above) A tapestry of bats: 14,500 individuals in a single mass, Marvel Cave, Missouri. These bats (*Myotis grisescens*) hibernate here and probably pass the summer in caves several hundred miles to the eastward*

*(Right) Weird shadows in a Pennsylvania cave: little brown bats (*Myotis lucifugus*), which enter this cave in October and do not leave until April*



Darkness

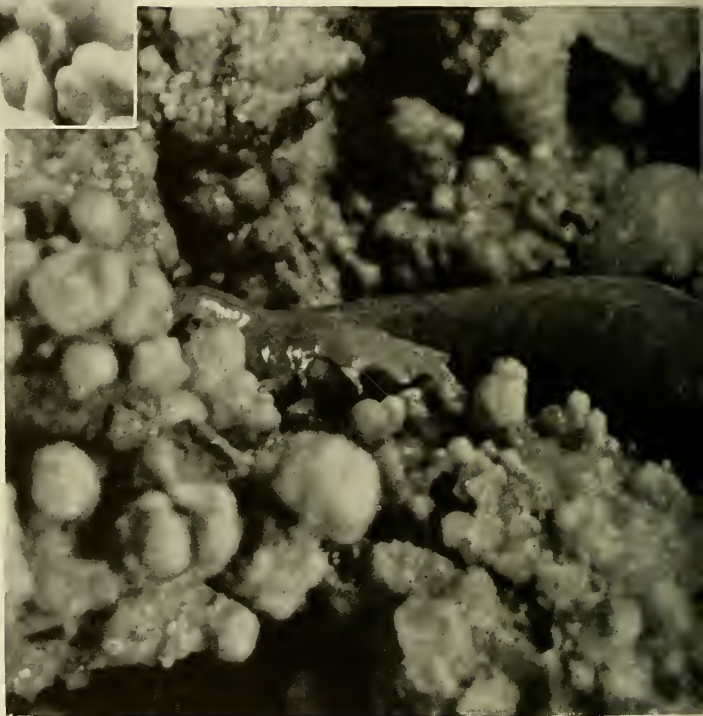
(Right) A fearless member of the underworld: the Allegheny cave rat, the eastern representative of the western pack rat. Unafraid of humans, he will frequently sit unconcernedly while you pass within a few feet of him



The famous blind fish, *Typhlichthys osborni*. A hazardous mile trip along Hidden River, in the cave of that name, brought the photographer to the specimens shown here. Curio hunters have greatly reduced the numbers of blind fish in Mammoth Cave and elsewhere in Kentucky, where they were once numerous



(Left) A flaming orange-colored cave salamander, Eurycea lucifuga. Born probably from eggs laid far back in Nickajack Cave, Tennessee, this creature is gradually making its way to the entrance



(Right) A difficult portrait: the blind cave salamander, Typhlotriton spelaeus, to photograph which the naturalist crawled through long water-filled passages in the Ozark Mountain region

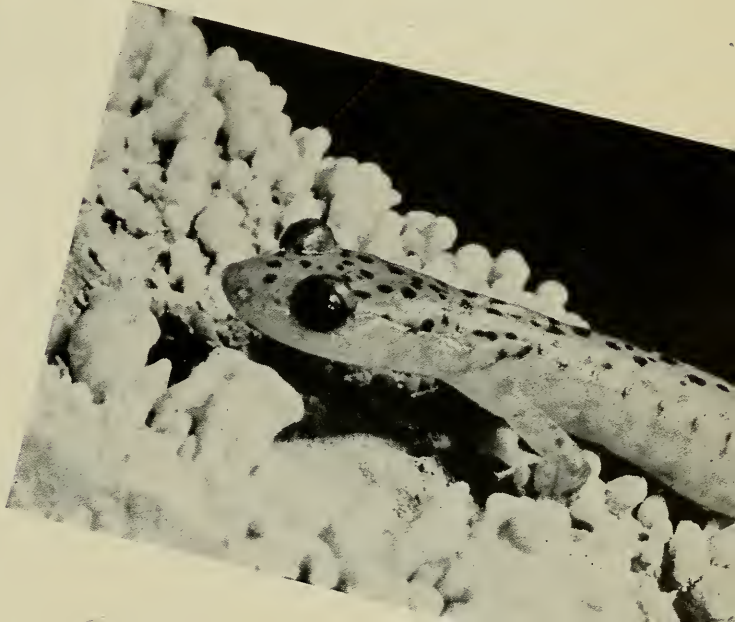


Where the blind eat the blind. Sightless crayfish and sightless fishes feed upon the sightless crustacean shown at the left. It was photographed making its feeble way through the shallow pools at Marvel Cave, Missouri

Ghostly pale in the rays of the flashlight was the salamander shown at the right, and so slippery that it squirmed right through the fingers of its captor. Though salmon in color, it is known as a "purple" salamander



*(Above) Another view of the so-called "purple" salamander, *Gyrinophilus*. This specimen was photographed far back in Hidden Cave, Kentucky, but the species is also found outside of caves
(Below) Orange-colored cave salamander*

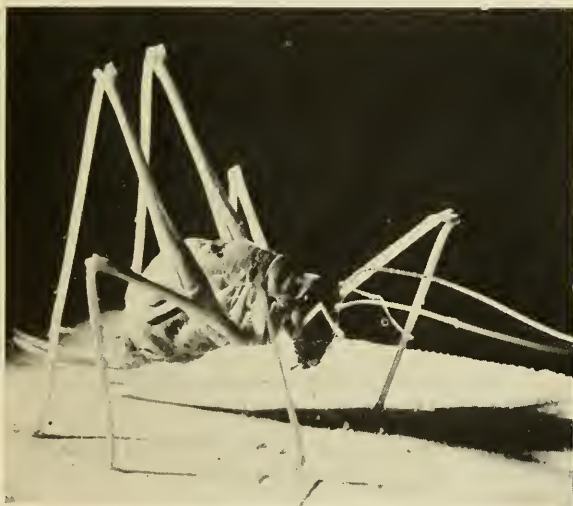




Happy is the collector whose flashlight reveals the strikingly beautiful blind white crayfish shown above. Sensitive hairs on its claws supplement its antennae as touch organs and com-



pensate for its rudimentary eyes. This creature is particularly abundant in Smalin's Cave, Missouri



The cave cricket, Hadenoeus subterraneus, is actually a long-horned grasshopper, with antennae three to four times the length of its body. It is wingless, but possesses well-developed eyes



(Above) A tiny "giant" less than a quarter of an inch long; a blind beetle in Old Salt's Cave, Kentucky. Unknown to most visitors these creatures live under damp wood or paper or along the banks of shallow streams

Your New Books by D. R. Barton

Man Immortalized—The Dearth of a Nation—Eskimos—Island Warriors—Prophecies

HEADS AND TALES

----- by Malvina Hoffman

Scribners, \$5.00

"My artist's soul was satiated and renewed during these journeys and I drank deeply of the peace and benediction of immensity."

IN 1930, Malvina Hoffman, was commissioned by the Field Museum of Chicago, to create the one hundred bronze figures that now stand in its Hall of Man.

This project was the crowning achievement of a life devoted to sculpture, and so it is but natural that in telling the complete story of the Hall of Man, the author should tell the story of her life.

Heads and Tales is such a book—a story within a story.

Miss Hoffman begins with the elopement of her musician father and her mother, touches upon her childhood spent in West 43rd Street, New York, proceeds to her student days abroad under Rodin, Mestrovic, and others, tells the thrilling story of a budding career—and of the world famous celebrities who sat for their portraits—Paderewski (to whom the book is dedicated), Pavlowa (who wept at her mother's death)—and of her intimate friendships with them.

This, in itself, would make a book—but suddenly scenes change. You see the war-wrecked Balkans through her pitying eyes—and then she embarks on her greatest adventure.

Miss Hoffman journeyed around the world, seeking out every place, however great or small, that any group of humans called "home." Studying, talking to, living with the subjects she was to immortalize in bronze. Many of them, she knew, as she made her preliminary drawings, were doomed to rapid extinction. Others she saw in dire straits she was powerless to relieve, and the immensity of her task flooded in upon her. All this is recorded in a vital, brilliant book, abundantly illustrated

with examples of her art and scenes that have influenced her thought.

Now, your reviewer feels it his duty to warn you that, at bottom, *Heads and Tales* are a woman's memoirs. And that when a woman writes her memoirs she achieves a warmth of emotion that seldom, if ever, finds its way into the similar work of a man. But there is one fault that seems indigent to all works of this nature. It might best be described as a certain lack of self-restraint which makes for misplaced emphasis, and—particularly when the author is an artist dealing with science—a tendency toward dangerous assumptions. When she insists on, "artistic freedom to select at least the best possible representative of a race, and not the ugliest"—she is approaching a confusion of terms. The inner workings of Nature are not governed by the touchstones of human aesthetics—purity of either line or strain are apparently not her ultimate goal.

This fact has, incidentally, been ignored by certain Germans in the formulation of their political philosophy—and while on that subject, your reviewer is forced to confess, that the philosophy expounded by Miss Hoffman at the close of her book is not over meaningful to him.

RICH LAND, POOR LAND

----- by Stuart Chase

McGraw-Hill, \$2.50

"A lovely, vital continent has been outraged and betrayed."

STUART CHASE'S book leaves you one comforting thought—the grass will not grow in the streets of our cities. Unhappily, however, for your peace of mind, it will not grow anywhere unless something drastic is done about a nation-wide conservation of natural resources.

Rich Land, Poor Land, is a clear-eyed expert's final report to his countrymen on the state of the nation, and is probably the most skilfully contrived inventory in history.

The forests, streams, wild life, farm lands, coastal waters and minerals of a vast continent are flung into Mr. Chase's utterly honest scales, and in nine cases out of ten, found desperately wanting.

From the moment white men first began seething over the Alleghenies, to the present day, the country has been settled, operated, and scandalously exploited under the concept of infinity. Next to nothing was done about conservation. There was always more land—plenty of it—farther west. Always more trees, more birds, fish, coal. Hence, the lumber baron's laconic philosophy of "cut out and get out." Hence, the bare hillsides. Hence, the floods. Hence, the death of the last passenger pigeon in 1914, and the disembowelment of a continent beyond all reason.

Nature spent thousands of years slowly accumulating her bounty. Came "the white-faced blight," and two centuries of organized rape. One truth shines out above all others in this book—the mechanics of speculative exploitation for quick profit are simply not compatible with the eternal laws and processes of Nature. We have worked against Nature for too long and retribution is at hand. We must either utilize every atom of accredited scientific knowledge in an effort to heal the wounds ignorance has inflicted on the living tissue of these United States, or we will bleed her to death, and as a consequence be faced with starvation.

Nor are there ways of escape through the miracles of synthetic chemistry and technical improvements. They too, the author clearly demonstrates, are dependent in large measure on conservation.

As well turn a flock of school children loose in a highly equipped chemical laboratory, and expect no ill effects, as throw open the resources of a continent to a horde of incredibly energetic, but appallingly uninformed people—endowed with the insight of a pawnbroker, the foresight of a prize heifer. They were plainly not responsible for their actions. The devil of it is that we are.

Leather-lunged spokesmen of certain organizations in our midst are currently prating about the debts our children will have to pay. These gentlemen should turn to Mr. Chase's book. They will find therein material aplenty for their cause; facts and figures so adroitly arranged, arguments so brilliantly presented, that they could be inserted chapter by chapter into any oration of the broadest appeal. Perhaps this may come about.

Who can tell?

LIFE OF THE SHORE AND SHALLOW SEA - - - by Douglas P. Wilson

Ivor Nicholson & Watson 12/6

HERE is a popularly written, finely illustrated book on the sea life that abounds in the waters surrounding the British Isles down to about the one hundred fathom line. Laity as well as the professional biologist will find a wealth of fascinating material within its pages. The author, Mr. Douglas P. Wilson, M.Sc. is Assistant Naturalist to the Marine Biological Association, at Plymouth, England.

THE REPTILES OF NORTH AMERICA - - - by Raymond L. Ditmars

Doubleday, Doran, \$6.75

THE first edition of this book appeared 29 years ago under the title of *The Reptile Book*. Since that time 28 new species of snakes, 47 lizards and 10 turtles have been discovered, and many new sub-species have been named. Doctor Ditmars, probably the country's foremost authority on reptiles, has undertaken the formidable task of rendering a wholesale revision of his book. He has rewritten nearly all of his earlier classifications, added fresh ones, furnished new identification keys and brought the work completely up to date. There is no phase of reptile life that is not touched upon.

Intimate observations on the habits of snakes, lizards and turtles, in wild state as well as captivity are included. Many interesting comments on the human approach, and the authentic cures for various snake bites are given in full detail.

The new edition is a surpassingly handsome example of the publisher's craft. The type and paper present the utmost in readability. The text is embellished by eight full color plates and more than 400 striking photographs from life.

No effort has been spared in creating a book that is both an exhaustive guide to the identification of all reptilian species inhabiting the United States and Northern Mexico, and a fascinating collector's piece.

MORE SIMPLE SCIENCE

by Julian Huxley and E. N. da C. Andrade

Harper and Brothers, \$2.50

MORE SIMPLE SCIENCE is a sequel to the co-author's previous work *Simple Science*, and like its predecessor combines accuracy and readability in such seamless fusion as to rank high among the most enlightening books of the day.

More Simple Science deals with the earth we live in, its scientific history, what it is made of, how creatures come to life in it and how all this should influence the conduct of our daily lives.

The forests, streams, wild life, farm lands, into friendly contact with the basic principles of chemistry, physics, biology and human physiology. The sequel cleanses geology, chemical agriculture, human and animal embryology, of the bewildering documentation with which they are too often surrounded, and presents them in shining clarity before the reader's eye. But this is not merely an easily digestible Baedeker of science. Messrs. Huxley and Andrade are motivated by a nobler aim. Their book is calculated to instil in the common man a comprehensive understanding of himself and his natural environment; to equip him to think about every-day problems accurately, and to make his

decisions from an informed point of view. And, in a world where the theory of democratic social order is threatened on every side, what purpose could be more praiseworthy?

"Without science and the scientific spirit," we are warned, "we shall just drift along; with their aid, man may be able to learn how to control his own destiny."

SWISH OF THE KRIS

----- by Vic Hurley

E. P. Dutton & Co., \$3.00

"The Moro is poised at a crossroad. He can accept the peace the Filipino offers or he can, with equal facility, pick up the bloody kris."

VIC HURLEY has written an attractive, but none the less, exhaustive book on the history and entire social structure of the Moros, unconquerable inhabitants of Mindanao in the Philippines.

The *kris* can be longer than the European sword, or as short as the stiletto. Whatever its length, the blade's keenness is unsurpassed. Wielded by the Moros, it has been the tangible means of keeping a remarkable race invincible—first, at the dawn of the Christian era, as conquerors of Mindanao; then for nineteen centuries of resistance to native invaders, Spain and the Americans. There are about five hundred thousand Moros compared to the twelve millions in the total population of Mindanao, yet their race is so hardy an organism that, *kris* in hand, they alone have remained independent while the rest of the Philippines have succumbed to the "civilizing" influences of the governments of Spain and the United States. Mr. Hurley's book is an investigation of this almost unique phenomenon, and a search for its causes.

Warriors by birth, the Moros have always scorned agriculture or any other peaceful means of livelihood. They have even developed an art of poisoning fish in such a way that they remain edible, rather than concentrate on organized fisheries. They are chronic pirates, marauders, pillagers—murdering for no other purpose than to test the blade of a new *kris*. Such a race was made-to-order for the Mohammedan religion they espoused. Successive generations, reared in the faith, are trained to battle believing that bravery spells paradise, the slightest cowardice, hell.

These facts, Mr. Hurley feels, explains Spain's inability to subdue the Moros. Even the cruelties of the conquistadors, so efficacious in Mexico and Central America, were powerless against these brown defenders of Islam. And the Spaniards tried every means in their quite unpleasant repertoire, as the author shows by quoting from their own records.

Swish of the Kris, is at once a document of sociological importance, and a fantastic story of unbelievable brutality and barbarous living. Mr. Hurley's close association with the Moros has given him an admiration for their indomitable courage, which is carried over to the reader.

THE STUDY OF MAN

----- by Ralph Linton

Appleton-Century, \$4.00

ANTHROPOLOGY is marked by the characteristic of every young science, in that it is divided within itself into divergent schools of thought. Doctor Linton feels, however, that his field of endeavor has reached sufficient maturity to warrant a clean cut, comprehensive, and unbiased book that will serve both the layman and the student, as a well-founded introduction.

This is what *The Study of Man* was intended to be—and what it is. The author is willing to go just so far with each of the warring factions—but he steadfastly declines to go the whole hog. He takes what he considers the most valuable contribution of each, and includes it in a text that treats accurately and fairly every aspect of Anthropology—human origins, the significance of racial differences, marriage, tribe and state, discovery and invention, orientations of culture. In addition he submits a new theory of race which corresponds more closely to the tenets of modern biology—and establishes a link between culture and animal behavior.

THE ESKIMOS

----- by Kaj Birket-Smith

E. P. Dutton, \$5.00

"... it has been my goal to write in such a way that it can be understood by anybody."

KAJ BIRKET-SMITH may have left some stone unturned in his treatment of *The Eskimos*, but if he did, only another expert could put a finger on it.

The Danish Anthropologist discusses every aspect of Eskimo life. Language, crafts, hunting methods, house-building, diet, taboos, religion and philosophy—all are portrayed in a vivid, pictorial style ably preserved by his translator Mr. W. E. Calvert. His book, amply illustrated, is truly one that can be understood by anybody.

No branch of the human race, is faced with so severe and grudging an environment as these fur-clad hunters of the north. Mr. Birket-Smith acquaints you with each problem of existence as it presents itself to the Eskimo; tells of the difficulties of sledging, how the sledge-runners are lubricated, and how a certain clergyman maintains that "oaths used when sledge-driving will not be included in the account on Judgment Day." He takes you into soot-blackened igloos, and on hunting trips where Eskimos travel great distances on foot and aboard their treacherous but silent kayaks, stalking seals and caribou by disguising themselves as, and emulating the actions of, these animals.

Some of the Eskimo's habits will horrify you a little—the half-digested contents of a caribou's stomach are regarded as a delicacy—but don't feel

too superior, for the garments made by Eskimo women, are indicative of far better taste than some of the night-marish creations, used by Parisian cour-turiers to stimulate sales.

PRIDE OF LIONS

- - - - - by Bertram F. Jearey

Longmans, Green & Co., \$2.50

"We were out to photograph, not to kill."

IN choosing his title, B. F. Jearey shows an almost Shakespearian flair for double meanings. Technically, "pride" is to lions, what "pack" is to wolves—and while Mr. Jearey's book most certainly is concerned with large numbers of lions, and teems with striking photographs of same, its fundamental concern is with pride, the human characteristic, as it is evinced by the king of beasts—the pardonable conceit that is his royal birthright.

Mr. Jearey likes lions. They charge his automobile, make fierce war at his arm's length, stalk his camp at night—yet they fascinate him so much that he exclaims, while watching cubs devour their first kill, "The snarling, spitting ferocity of them was delightful!"

Mr. Jearey feels that his own species have been too long peering at Leo through the sights of rifle barrels, and that such tactics do not develop a true understanding of him, nor contribute toward a curtailment of the needless dread in which he is held by most humans. He suggests a more intelligent and friendly instrument of the chase, and proves by an astounding collection of photographic trophies, upheld by a brightly written text, that not one iota of danger, thrill, valor or exaltation, is removed from the lion hunt wherein the camera is substituted for the firearm.

Pride of Lions, is a series of interpretative sketches, often witty, always entertaining—of lion life in particular, and animal life in general, as it is lived in the African Veldt.

Its author has words of praise for Kruger National Park, and a message of hope that, through its good work, the relations between men and lions will in the future, be characterized less by gun and claw, and more by a mutual understanding and respect.

THE GAUCHO MARTIN FIERRO

- - - - - by Jose Hernandez

Translated from the Spanish by Walter Owen

Farrar & Rinehart, \$3.00

*"By the song I sang in the days gone by
That now I sing to you."*

THIS Book of Verses may well be called the national epic poem of the Argentines. The first part, *Martin Fierro*, was published in Buenos Aires, in 1872, the second part entitled *The*

Return of Martin Fierro, appeared seven years afterward. The poem, alive with the earthy vernacular of its hero, and compelling in the passionate realism of Hernandez's descriptive powers, has been rendered into English with superlative skill by Mr. Owen. It is the very stuff of folklore. Part one is a comprehensive depiction of the life and times of the Argentine Gaucho, part two tends more toward a portrayal of the political corruption and social injustices that attended the arrival of the age of materialism in South America. An age which had no evolutionary use for the Gaucho, and which, therefore, practically exterminated him.

In Mr. Owen's own words the poem is "... a tale of bygone days ... and of a time which seems to keep closer measure with man's heart-beats than the age which has succeeded it."

Martin Fierro was a hard fighting, hard drinking, hard riding hombre. The prototype of his kind, he has much in common with our own cowboy of fictional fame, and should easily prove as colorful a character as any in our vast store of frontier literature.

The book had a tremendous critical success in England, and the first copy to leave the presses was accepted by Edward VIII, then Prince of Wales.

SALAR, THE SALMON

- - - - - by Henry Williamson

Little, Brown, \$2.50

*"Salmon, stream-shapen and wave-wrought,
revealed by only a momentary bulge in the
smooth bend of water."*

NINE years ago Henry Williamson was awarded the Hawthornden prize for his remarkable novel, *Tarka, The Otter*. In his new book he strengthens his enviable reputation as one of the most gifted Nature writers of our time. *Salar, The Salmon*, tells the story of the salmon, from birth to death. Tells it dramatically, epitomized by the life and death of Salar its hero.

Mr. Williamson has literally lived among Salmon. There is a home-made hatchery almost at the doorstep of his house. He has spent days, nights, years patiently observing them.

His book is an incomparable fusion of scientific accuracy and the gift of translating the authentic workings of Nature into a beautifully liquid prose.

Salar's adventures are the adventures of all Salmon. He has his enemies—the blood-sucking lamprey, the fishermen, and man-polluted waters—to name a few, and his friends—Trutta, a very old sea trout, and Gralaks, the grisle.

Mr. Williamson seems to know how Salar feels. This sympathy between hero and author is due partly to painstaking observation and scientific deduction, partly to a secret communication between artist and subject which makes the reading of this book a rare and delightful experience.

THE STORY OF PROPHECY

----- by Henry James Forman

Farrar & Rinehart, \$3.00

"Our own crucial period, through which we are now passing, has been long foretold, with considerable detail, by a very chorus of voices crying in the wilderness."

PROPHECY, as treated by Henry James Forman, is not a matter of scientific calculation making possible the prediction of future events. It is rather, a mystic phenomenon manifesting itself in trance-like revelations to persons of unusual clairvoyance. *The Story of Prophecy* is an historical study of predictions made throughout the centuries. The author recalls the importance of the Delphic Oracle of classical times, and the astrologers of the middle ages. He cites numerous examples of prophecies which have been fulfilled, both in the case of individuals, and of nations. Records indicate that there were at least twenty prophets of the French Revolution, making their predictions in considerable detail, at a time three centuries prior to the event.

Prophecies of a very real interest to the present-day reader are allegedly inherent in the structure of the Great Pyramid of Cheops. Constructed at about 2900 B. C., it preserves in its mathematical dimensions and proportions, all of the scientific knowledge of Ancient Egypt, together with an elaborate prophecy of world events from Biblical times until the year 2001 A. D. Mr. Forman enumerates many of the prophecies of the pyramid, as deciphered by a vast contemporary school of "pyramidologists" who attribute great significance to the revelations of ancient Egyptians. The latter sections of the book are devoted to a description of these and other prophecies relating to the immediate future of the world today. All evidence seems to point to the conclusion that the greatest prophecies have been directed toward our own era, that the Pyramid of Cheops was constructed for the especial purpose of revealing knowledge to the world of the Twentieth Century, A. D., and that we are now about to enter an age of great awakening and glorious intellectual and material expansion. Mr. Forman brings our day even further into the limelight by saying, "To many prophets and in numerous prophecies, the year 1936 marks a great turning point in human life and in human destiny." Optimistically, he shows that this turning point is the initial step toward a new golden age.

In evaluating the significance of this wealth of prophecy, the author points out that in our civilization, most people do not admit that they believe in prophecy. However, he remarks, "A little closer inquiry will lead the reader, as it has led the writer, to conclude that almost everyone believes in prophecy—with the possible exception of the average scientist." Despite a lack of scientific credentials and after careful consideration of the material at hand, your reviewer stands pat—numbering himself among the infidels.

SKYWAY TO ASIA

----- by William Stephen Grooch

Longmans, Green, \$2.50

"If you've never looked at a ten-foot shark in the eye at close range, you've missed a thrill."

PERHAPS the most fascinating thing about this book is its jacket.

Mr. Grooch's publishers have really outdone themselves in the fine art of giving a volume eye-appeal on the display-shelf. Not that the book itself isn't worth your while. It is. But that jacket is a handicap. The book has never been written that wouldn't have a hard time living up to it.

Skyward to Asia, is a rollicking, breezy account of the first North Haven Expedition, sent forth by Pan American Airways to establish commercial air bases across the Pacific Ocean. Mr. Grooch, aviator and ex-navy man, was in charge of the expedition which established stepping stones for the clipper ships at Midway, Wake, and Guam Islands. His is a personal record, not an official one and he writes it with verve, skill, and abundant humor. Many difficulties had to be surmounted en route. Supplies were delayed, hands were mashed handling the heavy machinery, wells had to be dug—but all in all, when you have finished it, your temptation will be to look out at the city's street and sigh.

Mr. Grooch has an eye for Nature too. He describes the birds, fish and wild life . . . that thrive in these islands—his observations on the Gooney and the Hermit crab being particularly noteworthy.

SEVENTY YEARS OF IT

----- by Edward Alsworth Ross

Appleton-Century, \$3.00

"I learned the inexorable properties of things"—"if you don't tackle them as they really are, you are never able to manage them."

SEVENTY YEARS OF IT is the autobiography of one of the country's most out-spoken educators, Professor Ross of the University of Wisconsin's department of Sociology.

All his life he fought for the things he believed in, hated deceit, and bowed only to the goddess of truth to whom his life's work is dedicated.

His book is one of the most ruggedly honest achievements that has come along in many a day and expresses in a full-flavored, incisive style, a liberal's outlook on the world at large.

Mr. Ross has explored China. He has traveled South America, Mexico, South Africa, India—and was dispatched to Russia shortly after the revolution, by the American Institute of Social Service.

In his autobiography, he has set down an impartial sociologist's keen observations on everything that came beneath his gaze and has taken sides courageously in many of the controversies, in which our country is faced today.

THE MAMMALS AND LIFE ZONES OF OREGON - - - by Vernon Bailey

Superintendent of Documents,
Washington, D. C., \$75

THIS book is a four hundred and sixteen-page illustrated report, by Vernon Bailey, who was retired in 1933, after forty-six years of active work for the Biological Survey.

The object of the book is not only to provide as full information as possible, but also to give an impetus that will enable others to go ahead with future studies, until far better means for understanding, appreciating, managing, and controlling our native fauna are attained.

NOVITATES

No. 877. Notes on the Anatomy of the Viscera of

the Giant Panda (*Ailuropoda melano-leuca*). By H. C. Raven.

No. 888. On the Phylogenetic Relationships of the Giant Panda (*Ailuropoda*) to Other Arctoid Carnivora. By William K. Gregory.

BULLETIN

Vol. LXXII, Art. I.—Further Notes on the Gigantic Extinct Rhinoceros, *Baluchitherium*, from the Oligocene of Mongolia. By Walter Granger and William K. Gregory.

Vol. LXXII, Art. II.—Some Features of the Cranial Morphology of the Tapinocephalid Deinocephalians. By Lieuwe D. Boonstra.

Vol. LXXII, Art. III.—The Cranial Morphology of Some Titanosuchid Deinocephalians. By Lieuwe D. Boonstra.

Vol. LXXII, Art. IV.—Hyraxes Collected by the American Museum Congo Expedition. By Robert T. Hatt.

Science in the Field and in the Laboratory

*Birds of the Alps—Animals from Colorado—Pacific
Pearls—Lectures on Gems.*

Harry Snyder Colorado Expedition, 1936

George G. Goodwin, Assistant Curator, Department of Mammals, returns from field work in Colorado, bringing back over 300 specimens. He visited high regions on the western slopes of the Rocky Mountains in northern Colorado, and carried on work in three different types of country. His first camp was in sagebrush and arid regions; later, he camped on the open rolling range country above timberline at 10,000 feet, and his last camp was in timber country at 8000 feet, near Trappers Lake. He brought back specimens of the coney from the rock slides on the mountain tops. Specimens of the rare water shrew from the cascading mountain streams—these little creatures, no more than two inches long—rank high among the best swimmers of the non-marine animals. They can swim, dive, float, run along the bottom of a pool or creek, and actually walk on the surface of the water. He also brought back specimens of the pigmy vole, from the high, dry, mountain ranges, 13 striped and spotted spermophiles, golden mantle chipmunk, badger, long-tailed weasel, jumping or kangaroo mice—queer little animals that sit upon their hind legs and jump like kangaroos—and other species.

Mr. Goodwin's research work was carried on under diversified conditions. He experienced the

torrid heat and drought, cloudbursts and forest fires, dust storms that blotted out the landscapes—and the beautiful, clear air of the summit of the Rocky Mountain tops. He lectured at the Women's Club in Meeker, and entertained the local people with two showings of motion pictures at the theater.

This collection, along with specimens he brought back in January from Colorado, brings to the Museum a good representation of all the mammals in summer and winter coats found in that region.

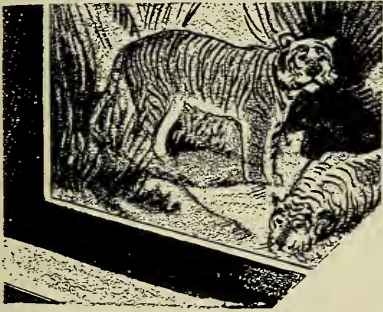
New Size and Title for Planetarium Bulletin

The Hayden Planetarium publication, *The Drama of the Sky*, will change to a larger size beginning with the November issue which will be entitled *The Sky*.

New York Academy of Sciences' New Quarters

The American Museum has furnished the New York Academy of Sciences with new and spacious quarters located on the fourth floor of the Roosevelt Memorial Hall. There is ample room for about one hundred members to convene, as well as equipment for illustrated lectures.

MUSEUM ANIMAL THEATRES



See what the famous explorers saw in Africa and India! Powerful lions, chattering gorillas, swift tigers, trumpeting elephants. It's a thrilling education to look into JUNGLE TRAILS!

Materials for making these FOUR THEATRES—lions, tigers, gorillas and elephants—come in one big box for a dollar. Also you'll find in the box, maps and a brief story of each group. Scores of jungle scenes and combinations can be staged with real life effect!

Sold only in sets of four for \$1.00. Including postage, east of Chicago, \$1.14. Including postage, west of Chicago, including all of U. S. possessions, \$1.32.

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THE AMERICAN MUSEUM OF NATURAL HISTORY
77th Street and Central Park West - New York City

Dr. Miner's Expedition for Pearl Fisheries Group

The serrated mountains above Honolulu's beautiful harbor glistened in the sun as the steamer *Lurline* ended her voyage from San Francisco on September 3rd. Among the passengers crowding her decks were Dr. R. W. Miner, Curator of Living Invertebrates at the American Museum, and Messrs. Wylls Betts and Chris Olsen his assistants.

They were accorded the celebrated effusive welcome of Hawaii, were lavishly photographed in floral garlands, and were later met by Mr. Fred Smyth, Museum Bursar, and Mr. Templeton Crocker, under whose auspices Doctor Miner and his staff are conducting an expedition to collect important material for the Pearl Fisheries Group in the Hall of Ocean Life, at the Museum.

This expedition left Honolulu, September 7th, aboard the boat *Zaca* which maintains a fully equipped laboratory. Christmas Island, about 1200 miles southwest of Honolulu, is the first port of call. From this point, it is planned to visit Penrhyn Island, Pago-pago, Apia in British Samoa, and on the return trip to stop off at Fanning Island. The expedition took five brass boxes of different types to be used in an extensive program of underwater photography, which, it is hoped will add considerably to the knowledge of underseas life.

If all goes well, the expedition will disband at Honolulu on the 13th or 14th of November.

Free Lectures on Gems

The American Museum will offer a free course of four informal talks on "The Appreciation of Gems," by Herbert P. Whitlock, Curator of Minerals and Gems.

The series and dates are—"The Story of the Jade: I," on Saturday, October 24th, at 4:00 P.M. "The Story of the Jade: II," Saturday, October 31st, at 4:00 P.M. "Amber and Near-Amber," on Saturday, November 7th, and "The Work of the Lapidaries of Imperial Russia," on November 14th, at the same time.

PROBOSCIDA, Volume I. Henry Fairfield Osborn's Last Work.

For many years before his death on November 6, 1935, Dr. Osborn was engaged upon this monographic revision of all known fossil and existing species of Proboscidea (mammals of the elephant tribe, usually provided with a proboscis, or trunk).

At the time of his death the greater part of Volume I, was already in type, but there was still a great deal to be done: many drawings and maps had to be made; there was much to add to the text and to the appendix from the author's later notes; the bibliography, table of contents, list of illustrations, etc., had to be completed; finally the whole volume had to be virtually reset and corrected.

Volume II, still awaits completion from the materials left by the author; but it is hoped that it will be published within the coming year (1937).

This work is assuredly one of the greatest documents bearing on the evolution of the mammals.

A new addition to the magnificent Hall of the Birds of the World in the American Museum of Natural History—depicting bird-life of the high Alps—was opened to the public on Sunday, September 13th. The group, given to the Museum by Mrs. Carl Tucker, contains no less than twenty-one species of birds shown in an Alpine scene of trees, shrubs and flowers which is as artistically beautiful as it is scientifically correct. The spectator is transported to the upper slope of Riffelalps at timberline. In the background the snow-clad peak of Matterhorn pierces the sky.

Dr. Ernst Mayr of the Museum's Department of Birds, which is headed by Dr. Frank M. Chapman, selected the locality for the exhibit as well as the bird-life presented in it.

The group was designed and the background painted by Francis Lee Jaques from field studies made by him in July, 1935. At that time, he also collected the accessories for the foreground. The preparation and installation of these accessories was done by George E. Petersen under the supervision of Albert E. Butler, Associate Chief Arts, Preparation and Installation, Dr. James L. Clark, Director. The birds were mounted by Raymond Potter.

"Birds are not abundant in the high Alps," said Dr. Frank M. Chapman, in explaining the group. "But those that are there tell a story of the remote past which forms an important contribution to our knowledge of the geologic history of these mountains.

"The upper, or Alpine zones of high mountains are like islands in the air. Many of the animals and plants inhabiting them are as effectively isolated by the warmer climate below them as though they were indeed occupants of oceanic isles. It seems evident, therefore, that they have reached their present homes under conditions which no longer exist and their presence, consequently, often gives us a clue to their origin and the geologic history of their habitat.

"When, therefore, we find such Himalayan birds as the Wall Creeper and the Snowfinch in the high Alps we realize that they doubtless reached there over the mountain highway that in the Tertiary Period connected Asia with western Europe. Possibly the rhododendrons of the Alps followed the same route.

"So also the Arctic Ptarmigan and the Redpoll doubtless came to the Alps when the ice cap of the Glacial Period extended as far south as central Europe. Finding a congenial home at a high altitude they remained there when the ice retreated. Other birds in the group have extended their range from the Palaearctic Zone at the base of the mountain upward to timberline. From this level they may retire to lower levels in the winter or they may migrate southward to Africa, such as do the House Martin, Wheatear, Black Redstart, Mistle-Thrush and Cuckoo."

The Museum staff feels that this exhibit is one of the finest yet offered to the public, and intends to maintain this standard in all forthcoming displays.



BIRD-LIFE—Of The Palaearctic Alpine Zone

A view of the Zermatt valley and the Matterhorn, in Switzerland, from an altitude of 7000 feet at timberline.

Penguins in Captivity

The Emperor Penguins obtained for the Chicago Zoölogical Society by the Second Byrd Antarctic Expedition have all died of a respiratory disease in the Society's park at Brookfield. This latest attempt to maintain in captivity the most southerly breeding bird in the world has thus led to the same results as all previous experiments.

With many other species of penguins, however, success has been much more marked, though less so in America than in Germany and Great Britain. Well deserved good fortune, for example, has crowned the long efforts of Mr. T. H. Gillespie, Director of the Zoölogical Society of Scotland, at Edinburgh. This summer Mr. Gillespie has under his charge 160 penguins representing five species, and a goodly number of these birds are one or two generations removed from their wild ancestors. King Penguins, Gentoo Penguins, and South African Penguins have been bred in captivity at Edinburgh for several years. During 1935, the first Rockhopper Penguin was hatched and reared. A Ringed or Antarctic Penguin also came through the incubation period and broke out of its shell, although it survived thereafter only four days. During the present season the adult Ringed Penguins have been nesting and sitting again and better luck is hoped for.

Mr. Gillespie writes that with 35 healthy King Penguins and an even larger number of Gentoos and Rockhoppers, he would gladly sell or effect exchanges with institutions in America eager to obtain well acclimated penguins.—R. C. M.

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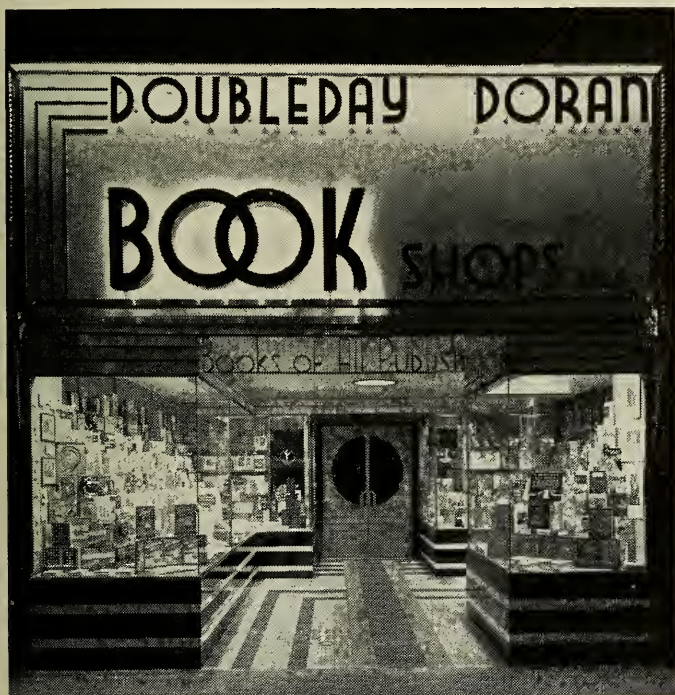
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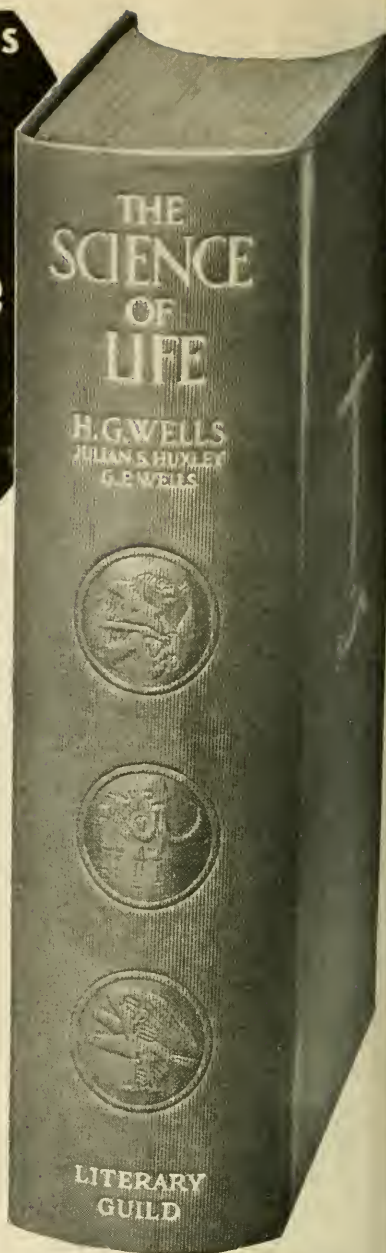
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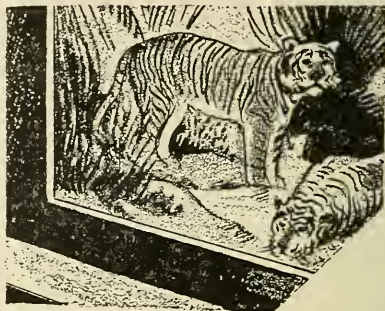
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VOLUME XXXVIII

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Horses and History

The story of the horse from earliest times: his place in war, peace and sport; and his claims to a lasting position as man's ally

By GEORGE GAYLORD SIMPSON

Associate Curator of Vertebrate Palaeontology,
American Museum

"When I bestride him, I soar, I am a hawk: he trots the air; the earth sings when he touches it; the basest horn of his hoof is more musical than the pipe of Hermes . . . his neigh is like the bidding of a monarch and his countenance enforces homage."
(Shakespeare).

BEFORE the dawn of history the thunder of flying hooves sounded among the green valleys of Gaul, across the broad steppes of the Volga, and the Caspian, and over the plateaus and the deserts of Tartary. That ancient singing of hooves, like the clash of distant cymbals, was to mingle with the voices of men and to go echoing down the long corridors of history. Indeed it was to be history, for the horse was to carry on his back the fates of nations and the hopes of civilization. When, in the course of our rise in wonder and in pain from our brute ancestors, primitive man first crept silently along shaded paths stalking dun and shaggy wild ponies, he created a partnership that was to help shape the destinies of both man and beast forever after. Hawk-like Arabs, fierce Tartars, mail-clad chevaliers, little yellow men and lean red men, innumerable hosts, were to woo the horse and to live with him and by him.

It is true that when horse and man first came in contact the beginning was conflict and not partnership. To the cave man, horses were big game and not companions or allies. At

Solutré, in France, one of the places where the histories of men and of horses first begin to unite into one twisted thread, there is a great pile of débris left by cave men who lived toward the close of the Great Ice Age, and that pile consists very largely of the broken bones of horses. There are thousands upon thousands of these bones—it is sometimes estimated that they represent nearly a hundred thousand horses—and it is evident that all these animals were eaten. From that time on (and probably from a date still more remote) there is evidence that horse-flesh was an important element in Stone Age diet, sometimes almost the only source of food. Perhaps partly for amusement but surely also for magical reasons, these remote ancestors of ours were given to portraying the animals important to them, and among these vivid portraits still preserved are dozens of horses, small statuettes, engravings on bone and ivory, and paintings on the walls of caverns. Some of these representations have seldom been surpassed in artistic spirit and, although all are to some extent stylized, many are so accurate that we can identify the exact race of wild horse intended. Most of them were closely similar to the only true wild horses left in the world today: the horse of the Gobi usually called Prjevalsky's horse.

Domestication

There is, however, no conclusive evidence that the men of the Stone Ages ever domesticated the horse, although their use of horses as food and their keen interest and observation may properly be considered as the first step that was to lead to domestication. When and where domestication first took place, or indeed whether it did not occur at more than

(Left) A splendid example of the Grecian æsthetic conception of the horse, dating from near the close of the Athenian Empire. Although mediocre horsemen, the cultured Athenians saw in the horse an artistic ideal

one time and more than one place, may never be exactly known, but we may infer that it was probably somewhere in central Asia and around 4000 B. C. Horses first appear in regular, written history between 2000 and 1500 B. C. The use of horses was then known in China, apparently from painful contact with the wild hordes of central Asia who were then already mounted, and also in western Asia and the Mediterranean.

There is still extant an Egyptian song of Rameses II, about 1350 B. C., in which highly developed use of horses in war is shown. "I am to them like Baal in his season," the king is made to boast, "their twenty-five hundred chariots are hacked to pieces before my steed." The common and abundant use of horse-drawn vehicles surely implies a long previous history of domestication, and indeed there is reason to believe that horses were known to both Egyptians and Babylonians long before this time, but it was only after 1500 B. C. that they became generally diffused in this area. Even then for a long period these civilized and sedentary people used the horse almost exclusively for military purposes and then almost entirely for drawing chariots. True cavalry was for them a late development and one to which they never became entirely adapted.

A dark horse

When horses thus first appeared on the western scene, there is little doubt that some of them, at least, had been ridden into the light of history out of the darkness of interior Asia, carrying barbarian raiders and nomads. The common type of barbarian horse, then as now, was similar to the cave man's prey and to the wild horses of Eurasia, dun-colored animals, not much over 13 hands high (4' 4") with short legs and large, coarse heads. At almost the same time, however, there appeared a very different sort of horse, likewise small by later standards, but dark in color (typically bay), delicate and fleet in build, with sensitive heads. There is no agreement as to the ultimate origin of these horses, but when they first appear they seem to be typical of northern Africa. Like so much supposedly dry ancient history, these facts are not really remote from our own lives. The blood of these dark horses flows now in the veins of every race-horse, polo-pony, hunter, and even of our more pro-

saic cart and plow horses. Apart from this, their appearance and their spread have repeatedly been a decisive influence in history. Were it not for them, our lives would now be profoundly different.

The Libyans or Numidians had such horses from a very early date, and not long after the first extensive use of horses in Egypt, the Egyptians were levying a tribute of horses on the nomad tribes to the west of them. The Libyans had chariots and are credited with the invention of the four-horse team, but they also and more commonly rode on horseback, and this before other Mediterranean nations habitually mounted. These horsemen were extremely mobile and swift and their light horses served them well, for the people themselves were slender and they reduced incidental weight to an absolute minimum. Greek paintings of about 600 B. C. show the Libyans, both men and women, riding astride, bareback, and themselves nude. In these paintings the horses have bridles, but later authors describe naked Numidians on unbridled horses, so that both steeds and riders performed in a complete state of nature.

The more civilized peoples of the eastern Mediterranean bred larger horses than either of the main purer stocks, Asiatic and north African, and in Persia and elsewhere lines of heavier crossbred animals arose. For developing and improving the qualities of these horses, the African stock was eagerly sought, and we find large sums being paid to the Egyptians for these blooded horses which they, in turn, seem to have derived from the Libyans. This crossing of Libyan horses, analogous to the Arabians of later times, with sturdier but slower northern animals is exactly the same process as has given us our thoroughbreds, and indeed almost all the breeds important in European history. This type of breeding arose several centuries before Christ, and, incidentally, before the Arabs had any horses.

In Greek art

The best horses of the Greeks are portrayed in the sculptures executed by Phidias for the Parthenon, and evidently were cross-bred horses of the type just described. Modern breeders remark that these stallions have numerous bad points and would have been hopeless in competition with our thoroughbreds, but the comparison is hardly fair and

our thoroughbreds would undoubtedly have been considered second-rate by the Greeks. At any rate, they and their neighbors had succeeded in producing mounts that were strong enough to carry a well accoutred warrior, considerably heavier than the slender Numidians with nothing on before and rather less than that behind, and at the same time fast enough to compete with the smaller breeds of that epoch. Whatever one may think of this more practical aspect of the matter, the Greeks must have loved horses and these sculptures are among the most beautiful things ever created by the hands of man. Their lovely, simple lines, the rich and flawless texture, their sure achievement, and their lively and sometimes almost humorous spirit are all incomparably fine. Had horses never done anything for man but to serve as models for these works of art, they would yet deserve an honorable place in the history of the human soul.

Despite this evident love of horse-flesh and the presence of numerous well-bred horses throughout the Golden Age of Greece, neither the Greeks nor the Romans after them were really great horsemen. They developed cavalry, but as fighters they were usually at their best on foot. Some of the Greek and Roman so-called cavalry was, indeed, really mounted infantry, for on several occasions we read that the soldiers rode to the battlefield but dismounted to fight. The horse was not an intimate part of the daily life of the whole people, nor even an irreplaceable element in their civilization. This has generally been true of the more sedentary races, and was particularly true of the nations of antiquity for with them the horse was seldom used as a work animal, donkeys and oxen usually occupying this essential economic position. The man who could afford to keep a horse as a luxury in times of peace and to raise him above the ruck of the battlefield in times of war had already before the sixth century B. C. become a privileged aristocrat.

A sign of rank

"The air and gracefulness of sitting a Horse," says Don Quixote, "makes gentlemen of some and grooms of others," and so it has been throughout most of European history. From the Hippeis of ancient Greece to the Chevalier, Caballero, or Cavalier of today, the man on the horse is the gentleman, the aristo-

crat, and the man on his own feet can only look up, admire and obey. It is the horse that makes the man. Most of the old privileges of equestrians have worn thin in this mechanical age, but the habits of twenty-five centuries die hard, and who can deny that even now the horseman is something special, a man apart, or indeed more than a mere man? The man who owns a horse, especially if it is a horse that he does not need for any useful purpose, quite rightly feels himself to be in a distinctive class, and is so considered not only by fellow equestrians but also by the humble pedestrian. This is a relic of the ages when good riding horses were much harder to obtain than good motor cars are now, gave their owners a much greater advantage over the rabble, and were the invariable touchstone of aristocracy. Even the mounted policeman of today inherits a mantle of command and authority from the knights and nobles of old, and inspires a respect not granted to his motorized or unmounted fellows.

Chariots vs. cavalry

The development of good riding horses led to the decline of the chariot, and of horse-drawn vehicles generally, among the Mediterranean nations. While horses were then still principally an adjunct of war, it soon appeared that a chariot corps could not successfully combat well-trained cavalry, and the chariot became secondary in importance, was diverted to other uses, and finally disappeared altogether. The development of wagons and carriages used for transporting freight and people seems to have been largely independent of the rise and fall of the chariot. The Scythians, who lived in wagons and were apparently among the first to use them, were great horsemen who had both chariot and riding horses in abundance, but their wagons were drawn by oxen, and there is much other evidence that the horse's demotion to a beast of burden or a work animal was usually secondary. In central and northern Europe the use of the chariot survived longer than around the Mediterranean, and there is some evidence that the use of the horse as a work animal is older there. The survival of the war-chariot has been ascribed to the small size of the native European horse, and we know that the Gauls were eager to obtain Mediterranean horses for breeding and that they did eventually develop effective

cavalry. By that time the horse was already their work animal, also, to an extent that to this day is not true of the Mediterranean countries.

Chariot racing

Long after the chariot had begun to decline as a useful implement, its use was kept up at Rome for racing, for which the Roman populace had an excessive passion. The four racing factions, which had their colors like those of a racing stable today, spent enormous amounts on these races and the charioteers were professionals, some of whom were as famous as any athletic world champion is today. The horses were mostly of Libyan blood. Chariot racing had, indeed, been a leading sport of the whole Mediterranean area for centuries before this, and racing with a ridden horse was begun at Olympia in 648 B. C. The winners of the great races were heroes beyond compare, and the horses themselves were fêted and commemorated in monuments and on coins. Poets sung their praises, and no channel swimmer ever received greater ovations from the people. At Olympia there were not only chariot races and mounted horse races, but also mule-car races.

It seems probable that the first time there were ever two horsemen at one place, the result was a race. All tribes and nations who ride horses at all run races on them, and almost as invariably there is some gambling on the outcome, from Patagonia to Mongolia and from New York to Shanghai. This is one element in the relationship between horse and man that is universal, and will probably be the last to disappear.

Even the use of horses for pure diversion, as in our circuses, is ancient in origin, for we read in Pliny that the Sybarites had trained their horses to dance to music at banquets. This feat was their downfall, however, for in 510 B. C. when they sallied forth on horseback to fight the wily Crotonians, the latter played the horses' dance music on flutes. The Sybarite horses danced and their riders were unseated and utterly routed.

Although the Greeks and Romans thus had all the elements of horse culture that have characterized the whole of European history, the fact that they were not great horsemen as a race was in each case an important element in their downfall. Macedonian dominance over the Greek cities can be largely ascribed

to superior cavalry, and the struggles of both Greece and Rome with the nations of the Near East, time after time bringing them to the verge of ruin, were prolonged if not made possible by the eastern superiority as horsemen, despite inferiority in most other respects. Rome's bitter struggle with northern Africa was long dragged out by the better mounted, harder riding African troops. Rome did, however, draw auxiliary cavalry from this same region that saved the Roman army at least once during the early invasions of Gaul. The Gauls, also, seem to have been superior to the Romans in cavalry tactics, although at first they were not so well mounted. Finally when the barbarians swept down on Rome, they were mounted on the best war horses then known and they were superb horsemen. Rome's decline and fall, for which so many causes have been advanced, can also be imputed in considerable part to horses.

Arabian a late arrival

It is a curious fact that while horses were playing a dominant part in the ancient history of the Mediterranean, the Arabian horse, which was to become the most famous and important in the world, did not yet exist as such. There is no evidence that the Arabs or allied Semitic tribes had any horses before the Christian era, although they already had camels. During the first few centuries after Christ, no one knows exactly when or how, some particularly potent strains of horses were introduced among the Arabs. These animals were for a long time few in number and their possession was confined to a few prominent men or families, but the stock was carefully perpetuated and increased so that by the time of Mohammed the Arabs had acquired great skill as horsemen and also a stock of phenomenally fine horses.

It would be difficult to overemphasize the historical importance of these Arabian horses. During the many long centuries of struggle for dominance in the eastern Mediterranean and western Asia, the Arabs had managed to hold their own in their sandswept deserts, but they had never been a source of danger to the surrounding lands. Thus they might have remained until the end of time except for horses and Mohammed. Mohammed preached the doctrine of Allah and fired the holy war; he also

preached horses. "Every grain of barley given to a horse is entered by God in the Register of Good Works," says the Koran to the horseman, and to the horse: "Thy back shall be a seat of honor and thy belly of riches." Mohammed's followers mounted their horses and rode off to conquer the world. The story of that conquest could almost be written in terms of horses rather than of men.

Mohammedan horsemen outclassed

The turning point came on the plains of Poitiers in 732. The Saracens had swept across northern Africa, had conquered Spain, had swarmed over the Pyrenees, reduced Bordeaux to ashes, and ravaged Aquitania. Their horses were galloping onward and European civilization was threatened with extinction. At Poitiers the lithe Moslems on light, swift Arabian and Barbary horses were opposed by the more sturdy Franks, clad in mail, and carried by the great European battle horses. The Saracens could not break the solid front of the heavy horses, their own flank was turned, and the fear of Mohammedan dominance in Europe was at an end.

All during the Middle Ages the European breeders were concentrating largely on producing heavy horses, whether for work or for war, and the light Arabian type was not prized, except for cross-breeding. For this purpose Arabian, Barbary, and other horses of the dark, slender southern races have always been in extreme demand, and the great horses of chivalry had much of this blood, even though they were so unlike this side of their ancestry. In Arabia itself the pure Arabian type is said to have been damaged by attempts to supply an almost unlimited demand for cross-bred horses. Thus the blood has spread over the whole world, and except for specialized breeding purposes, the progeny often excel the pure Arabian animals.

As armor became heavier and more complete, the knights' great horse necessarily became stronger and larger. Toward the end of this evolution, a horse with his own armor, a rider, and the rider's armor and arms was carrying about 500 pounds. Later a revolution in methods of warfare placed a premium on lighter and faster horses again. The cycle in England ran from William the Conqueror to Cromwell. The famous battle in 1066 was it-

self a testimony to the power of the horse in human affairs, for the Anglo-Saxons, afoot, lost the day to Normans of sturdy horses like those that destroyed the Saracens at Poitiers. At the other end of the long story, Oliver Cromwell mounted his famous Ironsides on light horses such as had already become popular in England through the development of racing and hunting, to the distress of more conservative military authorities, and they roundly defeated their opponents who were mounted on little-altered descendants of the medieval great horses. The heavier horses have, indeed, continued for coaching and draying, but most breeders have long concentrated on types like the strangely mongrel but wholly admirable, curiously named thoroughbred.

The Mongols and their horses

While European horses were plodding through the interminable and relatively petty affairs of the Middle Ages, a horse-borne plague swept over Asia. To the Mongols, horses were not merely badges of rank, implements of war, or sources of diversion and excitement. They were all these and much more. They were such an intimate part of life that life without them was impossible. They were friend, food, drink, buckler, shelter, god, and often life itself. There was no gentleman a horse and commoner afoot. Everyone had a horse, or if he had not, the first comer would probably give him one. Everyone rode hard almost from the day he was born until he died. Theirs was a true horse culture complex in which the horse was the dominant, the one essential feature. Mare's milk was the common drink and from it was made kumys by light fermentation, and fiery arak, a highly intoxicating liquor. On long marches the soldiers sometimes drank their horse's blood, without killing him. A horse skull was an object of worship in the old shamanistic creed. Horses were exacted as tribute or given as gifts, their numbers sometimes running into the hundreds of thousands. A horse's rights and worth were much on a par with a man's, and it is not surprising to read in the Yassa, the Code of Chingis Khan, that a horse thief must pay back nine animals for every one stolen or failing that must give his children in place of animals, or if he have neither nine animals nor children he shall be slaughtered

like a sheep (with very gory details as to the technique of his execution). Such provisions suggest the lynching of horse thieves in our own frontier days, when we also had a horse culture, but one less intense. We also learn (but on less good authority) that forty maidens and forty white horses were slaughtered on the grave of Chingis, and this is at least possible, for among many other horse loving nations horses have been used as sacrifices, and not infrequently humans also on the same basis as the horses. It is noteworthy also that white is often a sacred color for horses. White horses have been much in demand among the Arabs, for instance, even though they believed bay horses to be better in every other respect.

Such are a few of the more obvious and superficial features of an intense horse culture complex. In its deeper aspect it involves an almost mystical kinship of the horse and his rider, and in the case of these men, the Mongols, this cannot be overlooked as an essential element in their amazing achievement. Traveling and fighting on horseback they built the greatest empire the world has ever seen.

The horse comes to America

The closest parallel to such a culture complex based on the horse was developed among the men, both white and red, of the North American plains and South American pampas. It is well known that there were no horses living in America when the Europeans first landed here. On this occasion, as on so many others, horses at least accelerated history if they did not altogether change it. Cortez had only sixteen horses when he landed in Mexico, and probably never had as many as a hundred during the conquest, yet these were such objects of superstitious dread to the Indians and they acted so effectively against the Indian infantry that they did perhaps as much as any other single thing to enable his small band to perform the seeming miracle of conquering the greatest Indian nations.

Spanish horses escaped or were loosed in Mexico, in the Mississippi Valley, and near Buenos Aires, and they thrived so that both continents soon had vast herds of feral horses. The Indians took to horses with a whoop of joy and had soon so completely molded their lives around these animals that they seemed

always to have had them. So rapidly did this take place that many tribes had gone over entirely to the horse long before they had ever seen a white man. The tribal distributions, politics, and habits of almost all the plains Indians were profoundly altered by this new acquisition, and incidentally they were changed from relatively feeble and immobile groups into hard-hitting, fast-moving raiders. The white man's animal became the Indian's best ally in his struggle with the whites. As the West was colonized, horses were needed in order to travel, to handle cattle, and eventually to plough up the sod. We hardly need the "horse dramas" of Hollywood to remind us how inextricably the horse is linked with our own history. The blood of the steeds of the conquistadores still flows in the veins of our western ponies, but it has been much modified by crossing with larger animals of more recent importation, and the old mustang is now practically extinct.

Future of the horse

This generation usually assumes that the horse's rôle in history has been played to its end, and that our noble companion will survive only as a curiosity or an amusement. Certainly if the recent tendency toward mechanization continues, the horse can never again be as dominant a factor as in the past. At present, however, this mechanization is less advanced than most are inclined to think. There are still millions of people to whom the horse is the principal or only means of transportation and source of power. Even in our own country there are at present more than 10,000,000 horses on farms. There is no probability that the horse will ever lose his usefulness entirely, and if he did, yet he would still be cherished as a friend and as a source of pleasure. The horse will probably continue to have some share in human history as long as that history is made.

*"Yet if man, of all the Creator planned,
His noblest work is reckoned,
Of the works of his hand, by sea or by land,
The horse may at least rank second."
(A. L. Gordon).*

*"The air and gracefulness of sitting a Horse," says Don Quixote, "makes gentlemen of some and grooms of others."
(Right) An illustration by Gustave Doré from "Don Quixote"*



A PRIMITIVE wooden figure from the seventeenth or eighteenth dynasty, when Egyptian culture was just beginning to assimilate the horse

All photographs courtesy of the Metropolitan Museum of Art



(Below) A TINTED IVORY FIGURE, probably the handle of a charioteer's whip, dated at about 1500 B. C.

By 1350 B. C. the highly developed use of horses in war is confirmed by this song attributed to Rameses II: "I am to them like Baal in his season; their twenty-five hundred chariots are hacked to pieces before my steed"





(Upper left) BAS RELIEF commemorating the wars of Sargon II, King of Assyria. It was in this region that fourteen centuries previously the tamed horse had first been brought into a civilized community

(Upper right) ASSYRIAN WARRIORS in mountain country: relief from the palace of Sennacherib (705-681 B.C.), an even more illustrious conqueror than his father, Sargon II. He utilized horses extensively in his campaigns against Egypt and Babylon



(Above) HORSEMAN OF MARBLE (Rhodes). Date: fourth century B.C. Even before the sixth century B.C. the man who could afford to keep a horse as a luxury in peace and to raise him above the ruck of the battlefield of war, had already become an aristocrat

AN ETRUSCAN BRONZE showing the horse-drawn chariot used by the Italian civilization which preceded that of the Roman emperors, in whose hands it degenerated into a sporting device





© B. N. from William Thompson

CONQUEST OF BRITTANY
by Caesar, from a fifteenth
century engraving



(Above) GRAND FANTASIA in
modern Morocco. It was on steeds
such as these that the early Arabs
spread the religion of Mohammed



A PERSIAN version of the sedan
chair



THE HORSE of the Lamido of
Marua Cameroons, West Africa:
an interesting example of the na-
tive love of adornment



William Thompson Photos

*(Upper right) A NATIVE CAV-
ALRYMAN of Algeria. Even today
horses are used extensively in
desert warfare*



*RUSSIAN COSSACKS during the
Czarist regime, when they were
the most feared Asiatic horsemen*



*A HORSE does not have to be a
Derby winner to merit the affec-
tionate care of his master*

Globe Photos



HORSE PULLING CONTEST at a fair, an excellent portrayal of the muscular equipment of our larger work horses



Ewing Galloway

THIRTY "HORSEPOWER" REAPER. Ten million horses are still used on farms in the United States

MAN-O'-WAR, one of the greatest race horses of all time. It is probable that the first meeting between two horsemen resulted in a race. The competitive element is universal and will probably be the last to disappear



Photo by S. H. Chubb

(Below) POLO PONY AND HUNTERS, two examples of the horse as a modern luxury. The

horse will always have a place in man's life as long as there is a bond of mutual affection

Ewing Galloway

European

H. Armstrong Robert



“Relief” in the Sub-Arctic

The tragic economic story of the Northern Indians: a thirty-year decline from the freedom of their ancient hunting grounds to a place in the “breadline”

By PHILIP H. GODSELL

[The author, a veteran fur trader, has spent some thirty years among the aborigines of Northern Canada as an officer of the Hudson's Bay Company, and is the author of the book "Arctic Trader."]

The present article is particularly timely because it follows close upon a report issued by the Department of Indian Affairs at Ottawa stating that a large percentage of the Indian population of Canada is on relief, and because it has a bearing on the widely discussed problems of conservation and social administration.

As an institution for dealing with primitive peoples, the Hudson's Bay Company has perhaps had unparalleled experience, having operated since 1670 on a charter which makes it the oldest existing corporation in the world. The author's familiarity with this organization and with the Indians about whom he writes enables him to present a page from history which contains broad social implications.—The Editors.]

WHEN I stepped ashore some thirty years ago at the palisaded stronghold of York Factory—long the Hudson's Bay Company's capital in the Northwest—to commence my long and lonely years of apprenticeship to the “Gentlemen Adventurers,” the vast wilderness extending from Labrador to Alaska, and from the Great Lakes to the Arctic Islands, was one enormous game preserve. Nearly thirty million caribou roamed the Barren Lands. Each spring these animals migrated northward, the females leaving the bulls on the mainland and making their way

to the Arctic Islands to have their young. In the autumn they re-joined the bulls on the mainland and then migrated southward in order to reach the protection of the timber ere the winter blizzards lashed the Barrens from end to end with devastating fury. The forests to the southward were filled with moose and deer, while fur-bearing animals of all kinds native to the region were abundant. With their primitive muzzle loaders the Indians were unable to do any great destruction, consequently the foundation stock of the animal life of forest and tundra remained almost unimpaired.

Self-supporting

There were but few destitute Indians and Eskimos in the North in those days, and they were taken care of by the others. The Crees, the Chipewyans, the Ojibways and, in fact, all the Northern tribes still retained their pride of race and were engaged in their ancestral and healthful occupations: hunting, fishing and trapping. They traded their furs at the picketed forts of the Hudson's Bay Company which dotted the land from end to end, nestling like birds' nests beside the lakes and watercourses—the arterial highways of the land. True, the Indians did not receive high prices for their furs, but then their wants were simple, while the Company imported only the best of everything.

While, theoretically, the Hudson's Bay Company had surrendered their monopoly nearly forty years before they were still paramount throughout the greater part of the Canadian North, a factor which made it possible to protect the natives from those un-

favorable aspects which were always predominant when there was strong and active competition in the wilds. The Indian was recognized as an economic asset of the first importance since the entire success of the Fur Trade was dependent upon his well-being. Therefore, he was safeguarded and given a measure of protection in times of stress.

There was in effect at this time a profitable and thrifty system of "farming the forests" which had been in effect for centuries. Each Indian family owned their own individual hunting grounds which were handed down from one generation to another. These were distinguished by certain ranges of hills, rivers, creeks and other landmarks which formed the boundaries, and since each hunter's rights were fully recognized there was little or no poaching. Furthermore, this system lent itself admirably to a form of aboriginal game conservation.

Rotation of game

In the "Good Rabbit Years," when the woods were overrun with snowshoe hares, and the lynx and foxes that preyed upon them were plentiful, the beaver were left practically untouched, being permitted to multiply and thus form a reserve which could be drawn upon when other furs became scarce. For the fur-bearing animals, like the rabbits, multiplied, became inbred, were thinned out by epidemics, and then increased again within regular ten year cycles, only the "overflow" being trapped and disposed of to the fur traders.

But the twentieth century was destined to become an era of unexampled expansion and progress. Civilization and commerce, anxious to open up new lands and fill their coffers, pushed their steel tentacles ever farther and farther into the wilderness. Soon twin ribbons of steel girded the Barren Islands, and from the barren rocks of Fort Churchill there arose, almost overnight, a sub-Arctic port and a two and a half million bushel elevator. Pioneer settlers, misled by extravagant accounts of the fertility of the Peace River country, sold out their homesteads in Wyoming and Texas, threw their goods and chattels into ox-drawn wagons and hit the trail for the beckoning North. Soon the Cree and half-breed trappers of the "New Northwest" gazed with undisguised amazement and alarm at the ever-swelling stream of sleighs and covered wagons trekking unceasingly up from the southward

and disappearing into the heart of their ancestral hunting grounds.

But the death-knell to the free and untrammelled life of the Northern Indians was sounded when, shortly after the War, a pioneer railroad penetrated into the heart of the Peace River country, while another tapped the vast two thousand mile network of rivers extending from Fort McMurray to the very rim of the Polar Sea; the mighty Athabasca-Mackenzie system. This furnished opportunities which the acquisitive palefaces were not disposed to overlook. Soon the picketed log trading posts of a million dollar American concern—the Lamson and Hubbard Company—stood cheek by jowl with those of the Hudson's Bay Company throughout the land. Then, like a rolling tide, a motley horde of adventurers, white trappers and "free traders" swept Northward, spread out fanwise and worked their way up all the large rivers, streams and tributaries of the land. Leaving the end of steel in their scows and flat-boats they floated down the Athabasca, the Slave and the Mackenzie rivers, carrying to the natives the "blessings" of civilization in the form of alcoholic extracts and the ingredients for home-brew; jazz garters, silk dresses and French-heeled shoes for the dusky ladies of the wigwams, together with high-powered rifles and unlimited supplies of ammunition to enable the hunters to raise havoc with the remaining game herds.

A fool's paradise

The Indians were delighted. The war-time boom in furs was at its height, while the keen competition that ensued between contending traders forced fur prices far beyond those of the leading markets of the world. Spurred on by the desire to possess the gaudy luxuries displayed so tauntingly on the shelves of the trading stores the red men trapped as they had never trapped before, and there ensued an undignified and uneconomic scramble. Within three years the Indians had become thoroughly demoralized, their dependability destroyed, and their original honesty completely and effectively eradicated.

The Slavey, Yellow Knife and Dog-Rib tribes who inhabit this region had never borne the paleface much love, and when the Lamson and Hubbard Company brought a large number of white trappers in from the United States and elsewhere, grubstaked them and

scattered them throughout the country they looked on with bitter anger and resentment. For, unlike the Indian, the professional white trapper is out to make a clean-up in the shortest possible space of time. In the autumn he proceeds to build cabins every twenty miles or so along his trapline, then from the first snow-fall until the ice breaks up in the spring he is tirelessly on the go, and in the course of a single season will accumulate three or four times as much fur as an entire Indian family would over a period of years.

Poison bait

Anxious to amass riches by the quickest and most effective means these newcomers resorted to a more efficacious and deadly manner of acquiring furs than by the use of the steel trap and the deadfall. Promiscuously, and with lavish hand, they scattered poison baits along the hunting trails of the redskins, destroying many of the Indians' sleigh dogs and laying waste large areas of territory. For the use of poison was infinitely more destructive than the most intensive trapping could ever be. Animals swallowing these baits would frequently live long enough to escape deep into the woods and die, to be devoured by other forest dwellers whose polluted carcasses would destroy still others, and so it went. As soon as one section of the country had been denuded of fur-bearing animals the trapper would pile his belongings into his canoe after break-up and look for new pastures where the process would be repeated.

When the Indians saw these strange pale-faces taking casual possession of their hunting grounds, saw their dogs poisoned and their traplines dotted with the usurpers' traps and poison baits, they were consumed with overwhelming anger. They trapped intensively to prevent these hated "Long Knives" from getting too many furs, burned their cabins, and deliberately set forest fires to drive out the invaders. Consequently many thousands of square miles of forested country were burned over with an appalling loss of animal life; a drop in the water level ensued, drying up large areas of marshland which had been the breeding grounds for millions of muskrats, and those posts which, a few years ago, shipped out thousands of these small pelts to be converted into Hudson Seal found their shipments reduced to mere hundreds.

Then came the airplane which made these erstwhile natural game and fur preserves more accessible and vulnerable than ever. Nowadays trappers can hire an airplane to take them into new and previously inaccessible hunting grounds which would have entailed months, and even years of travel, in the old days. They can scout new territory from the air, and in the course of a few hours range over a wide area to select their winter trapping grounds. At least one trapper owns an airplane of his own, which enables him to cover a vast extent of territory, and renders him almost immune from Game Guardians, Game Laws, Mounted Police and State boundaries.

Airplane companies have grub-staked trappers, transported them into the hearts of the Indian hunting grounds, with adequate supplies of traps and other equipment, picking them up at the end of the season and allowing them twenty-five per cent on the gross value of their fur catch.

Consequently the Indian is entirely at the mercy of the trapper and the hunter, with little or no voice in his own protection and defense since he signed away all rights to the land the moment he placed his mark upon the Treaty made with the representatives of the Great Father.

The wilderness he once owned is being exploited as never before, and he, along with his ancient enemy—the Eskimo, is in a fair way, ere long, to become an even greater charge than he is at present upon the Dominion Government.

A race without a country

Some of the Western tribes, especially the Blackfeet, have been converted into more or less capable and successful farmers. But the Northern Indian is at the cross-roads. He is neither physically nor mentally adapted to compete with the white man either as a laborer, or in mining and industrial pursuits. His is not a farming country, but a wilderness of forest, rock and muskeg. He is, and will remain, in spite of all the education he might receive, essentially a hunter and a trapper, and if the game is not safeguarded he will either disappear as the Beaver and Sick-annie Indians of the Peace River are doing, or will develop into a permanently dispirited

(Continued on page 358)

The Meteor Craters in Estonia

"Footprints" left by visitors from outer space—Evidence of an astronomical collision that occurred perhaps two thousand years ago

By CLYDE FISHER

*Curator of Astronomy and the Hayden Planetarium,
American Museum of Natural History*

"THE most interesting spot on Earth" is the designation said to have been given by the great Swedish scientist, Arrhenius, to Meteor Crater in Arizona. Little did he suspect the existence of a whole group of such craters at his own back-door-step, as it were. Meteor craters constitute the visible effects, the footprints,—one may say,—of the only visitors from outer space that actually reach the Earth. Well may they engross the attention of geologists and astronomers.

Recently recognized

In Estonia, which before the days of Peter the Great belonged to Sweden, is located this group of a half-dozen such craters. Although of prehistoric origin, their true nature was not recognized until 1927.

Upon joining the Harvard-M.I.T. Eclipse Expedition, whose work in connection with the total eclipse of the sun on June 19, 1936, was mentioned in the October issue of NATURAL HISTORY, it was my fond hope before returning to America to fly over the famous meteor craters near the Stony Tunguska River in north-central Siberia. To my great disappointment, I was advised by the Soviet Academy of Sciences, and I believe with good reason, that it would be impracticable to do this in mid-summer. Consequently, I turned my attention immediately to the Estonian Craters, which I had all along hoped to examine on my way back from the eclipse belt in the U.S.S.R.

Leaving Leningrad on the evening of June

27th by rail, I was in Tallinn, the Estonian capital, early the next morning. This old Baltic city, founded more than 700 years ago by King Waldemar the Second, of the Danes, has miraculously preserved its medieval character. Apparently it has not suffered the ravages of war, although in one of the many towers of the old city-wall, namely, *Kiek-in-de-kök*, a number of large cannonballs may still be seen embedded in the masonry. The Old Town with its very narrow, crooked streets, flanked with high-gabled stone houses, its old ramparts and battlements still largely intact, the massive wooden doors, often carved, and in remarkably good condition,—is altogether a fascinating place. The old moats, however, have been filled and converted into fine promenades and paths which girdle the Old Town with a beautiful belt of green.

At the suggestion of Professor E. Opik, Director of the Tartu (Dorpat) Observatory (Estonia), I called at the office of Mr. Ivan Reinald, Mining Engineer, Inspector of the Mining Industry of Estonia, who had explored the craters that I wished to visit, and who had been the first to conceive and announce to the scientific world the correct theory of their origin.

Location

Very soon I was able to arrange a visit to the craters, which are located on the Island of Saaremaa (Oesel) in the Baltic a little way west of the main coast of Estonia. The quickest way to make the trip from Tallinn to Kuressaare (Arensburg), the capital of the Island of Saaremaa, near which the craters are located, is by autobus, with a small steam-

boat to carry one from the mainland of Estonia out to the Island of Saaremaa. It was my good fortune to spend two days at the craters, and one of these days was with Reinvald, who has studied them so thoroughly.

In picturesque surroundings

Kuressaare, or Arensburg, as it was known to the German Knights, is a quaint old town with a castle 700 years old. I think I have never seen such narrow sidewalks, many of them only about a foot wide, and some even narrower. In the evening it is interesting to see the cows on returning from pasture adopt these narrow sidewalks in preference to the cobble-stone streets. On driving from Kuressaare out to the craters about a dozen miles to the northeast, one passes through a level and fertile farming region with here and there a patch of forest trees remaining. As evidence of good farming, fine fields of wheat, rye, and clover and smaller patches of potatoes lined the roadsides. (We were told that Estonian vodka is made of potatoes, while in Russia it is made of rye or wheat.) Around the craters the peasants were making hay, this activity being at its height. Although a little late in the season, at the time of my visits (June 30 and July 4, 1936) the skylarks were still singing their ecstatic flight-songs over the peasants' fields surrounding the craters.

The main crater contains a beautiful, circular lake, which has long been known as Kaali Järv, meaning Kaali Lake. In fact, the name "Kaali" has come to be used for the whole group of craters of which there are six of undoubted meteoric origin. The diameter of the lake in the main crater is nearly 200 feet, while the diameter of the crater from rim to rim averages more than 300 feet. The crater rim or wall rises 20 to 25 feet above the level of the surrounding ground. The crater is bowl-shaped and quite symmetrical, the rim or wall being steeper on the inner slope than on the outer. The rim is well wooded with large forest trees consisting of elm, ash, maple, spruce and oak. I noted no pine or white birch, although both are common on the island. There are present many hazel-bushes, which are sometimes small trees, and a shrubby dogwood. On top of the rim is a shady trail extending clear

around the lake, a circular "lovers' lane," evidently much trodden. On one side of the lake (Kaali Järv) is a stone table used as a place to drink coffee by Baron von Moller, former owner of the Kaali estate on which the craters are located. The ground around the craters is level farming land which has been cultivated from time immemorial, no doubt for hundreds of years. The nearby town of Kuressaare is more than 700 years old.

One's attention is immediately attracted to the broken edges of the dolomite strata which jut out all around from the upper part of the interior wall of the crater, and to the fact that *these huge fragments are tilted upward* from the inside 30 to 40 degrees,—reminding one of similar conditions in Meteor Crater in Arizona. These tilted dolomitic strata are together about 25 feet thick, and they belong, geologically speaking, to the Upper Gottland (Silurian), which underlies the thin glacial drift in this whole surrounding region, and which is practically level where undisturbed.

Rock-flour

Beneath these tilted dolomites, Reinvald showed me a belt of white or slightly brownish powder containing soft pieces of whitish rock, which could easily be ground to powder between the fingers. Chemical investigation had shown that both the powder and the rock fragments were similar in composition to the surrounding dolomite strata. A bore-hole sunk by Reinvald showed that this girdle of powder is nearly 20 feet thick, and that it lies between the tilted fragments above and the undisturbed horizontally lying dolomites beneath. Evidently it constitutes a most striking analog of the rock-flour ("star-dust") at Meteor Crater in Arizona, the latter being Coconino sandstone which was crushed and pulverized by the impact.

Careful measurements of the lake-bottom were made on six radii, at every two metres, down to the soft muddy bottom,—the water being 25 or 30 feet deep, varying with the season. The soft, muddy bottom of the crater is therefore nearly 50 feet lower than the upper rim. Measurements were made on four radii, not only down to the muddy sediment, but also to the solid bottom beneath it. This investigation showed the muddy bottom to

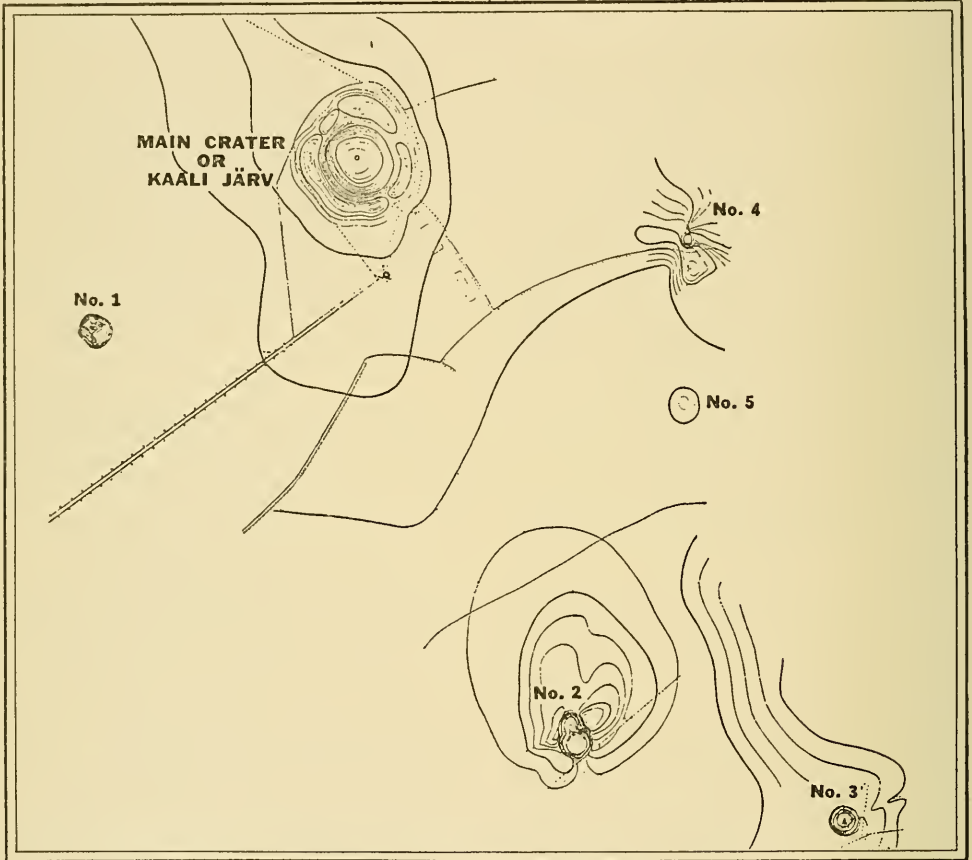
be nearly flat, while a funnel-shaped depression with a prolonged form was discovered in the hard bottom beneath.

The main part of this exploratory work was done by Reinvald in the autumn of 1927 by the order of the Mining Department of the Ministry of Trade and Industry of Estonia. In this work a bore-hole was put down at the base of the crater-wall on the outside to a depth of 207 feet, and two smaller bore-holes were sunk in the inside wall.

Besides the main crater (Kaali Järv),

there are five smaller depressions, undoubtedly of the same origin, scattered around it on an area of about one-third of a square-mile. The rims of the small craters, instead of being forested by large trees, are for the most part overgrown by hazel-bushes which in some cases cover the crater-bottoms as well. These craters vary in size from about 35 feet to about 130 feet in diameter. Their dimensions and characteristics are given in connection with the accompanying figure.

It is to be noted that Crater No. 2, unlike



WHERE METEORS STRUCK THE EARTH

The above map, embracing an area approximately a half mile square, shows the relative

positions of the six meteor craters in Estonia discussed in the present article

DETAILS

CRATER No. 1: 360 yards southwest of the main crater, and similar in shape; diameter, 120 feet; depth, slightly over 13 feet; tilted dolomitic blocks near the rim as in the main crater, overlying a girdle of powder.

CRATER No. 2: 930 yards south of main crater; oval in shape, about 175 feet by 120 feet; depth, nearly 12 feet.

CRATER No. 3: 275 yards east of No. 2; charac-

teristic bowl-shape; more than 100 feet in diameter and nearly 12 feet deep.

CRATER No. 4: 275 yards east of main crater; characteristic bowl-shape; diameter, 65 feet; depth from 2 to 4 feet; rim formation similar to main crater.

CRATER No. 5: 185 yards south-southwest of No. 4; diameter, about 35 feet.

the others, is oval. This fact Reinvald interprets as indicating that the crater was probably formed by two meteorites falling close together—a likely theory which can pretty surely be determined by careful excavation.

Effect of impact

Most illuminating in connection with Crater No. 4 is the condition of the central portion of the bottom. Though the feature has not yet been seen in any of the other craters, this is probably because they have not yet been excavated. The entire bottom, except for a small area in the center, is composed of fresh, hard dolomite in its original, undisturbed strata. But the central portion about 18 feet in diameter is a shallow depression about 16 inches deep, in the center of which is a blind funnel about three feet long by a foot and a half broad, and a foot and a half deep. This funnel is certainly the result of impact. By the curve in the thin marly streaks in the dolomite at the margin of the funnel (streaks which are horizontal in the unchanged dolomite), evidence can plainly be seen of the downward pressure of the meteorite at the time of impact. The 18-foot depression is surrounded by a zigzag broken rim, and the dolomite here is not fresh and hard, but is slightly deformed; it is cracked, slightly wavy, swollen, and has a burnt appearance. It is lighter in color than the fresh surrounding dolomite, is soft and easily cut by the shovel. From the streaks of marl and other characters, it is clear that this changed dolomite is still in situ. The burnt and somewhat shattered dolomite around the funnel, which was found by bore-holes to extend downward some 15 feet below the top of the funnel, is no doubt the result of heat developed by the impact of the meteorite.

A peculiar condition of the burnt dolomite is to be noted here, namely, it has been more affected by heat below the surface than at the level of the top of the funnel. In other words, there is a thin layer, or "skin," of comparatively fresh dolomite around the funnel covering the burnt dolomite beneath, indicating that the heat was radiated from the interior of the funnel, as one should expect.

This burnt dolomite constitutes an interesting analog of the fused quartz or *Le Chatelierite* at Meteor Crater in Arizona.

The main part of the crater with its elevated rim is undoubtedly the result of explosion, primarily from the sudden transformation of ground water, as well as the moisture in the dolomite, into steam, when the energy of the onward motion of the meteorite was instantly changed into heat. As stated by Reinvald, the size of the crater indicates the extent of the explosion, but the meteorite itself was of insignificant size in comparison with the dimensions of the crater. It is certain that the conditions were essentially the same in the formation of all the craters of this group.

Reinvald is planning to excavate Crater No. 5 next, although further evidence is not necessary to convince one that the craters were formed by the fall of meteorites, principally by the attendant steam explosion. This theory of origin was first conceived and stated in 1927 by Reinvald, and he has since found convincing evidence.

Meteoric fragments are lacking

It is true that no meteoric material has been found in or around the Estonian craters. If the meteorites which caused these craters were *iron*, as Reinvald judges on account of the strength and acuteness of their action, the pieces were probably carried away by the peasants, or by the earlier Vikings. Iron was prized by the Vikings; and it is known that the Danes, who were the founders of this Baltic province, had no iron in their home country. In support of this theory, it is also known that the Eskimos pounded off with tough rocks fragments of the Cape York meteorites, which Peary brought from Greenland, for the purpose of making knives. The Eskimos also used a small specimen of iron meteorite weighing between 3 and 4 pounds as a hammer. The latter specimen, which was found in Ellesmereland, was presented to the American Museum by Dr. W. Elmer Ekblaw of the Crocker Land Expedition. Here it may be seen together with the Peary meteorites from the same general region.

How quickly the meteoric iron has disappeared from Meteor Crater in Arizona and from the Henbury Craters in Australia with the influx of people! We have seen the meteoric iron disappear in the former case in less

than 50 years. While it is true that thousands of pieces have been picked up around the Arizona crater, it is now seldom that a piece is found even on this semi-desert. The Kaali Craters in Estonia are located in arable land that has been tilled for hundreds of years, thus providing ample time for the iron to be carried away. And then some forms of meteoric iron oxidize and disintegrate very rapidly. The absence of meteoric iron about the Kaali Craters does not prove that it has never been there.

After the explosion, the mass of the meteorite in all probability lay in the form of debris around the crater and partly in the mass falling back into the crater. Reinvald maintains that it is absolutely futile to search for the "main mass" of the meteorite in the crater itself, even if pieces should be found lying around.

As Reinvald points out, the group of Kaali (Estonian) Craters bear surprising resemblances to the Henbury Craters: (1) the craters have the same characteristic bowl-like form, besides the presence of an oval crater in each group, namely, Crater No. 2 at Kaali, and the "main crater" at Henbury; (2) the craters are approximately the same size,—12 to 120 yards at Kaali, 10 to 120 yards at Henbury; (3) in both groups the rims of the craters are partly formed by upward tilted blocks of the upper layers of the country rock; (4) there are signs of high temperature in both groups,—at Kaali, burnt dolomite,—at Henbury, pieces of fused sandstone; (5) in both groups there is found a fine powder mixed with coarser fragments of the country rock. The origin of the Henbury Craters, however, has been confirmed by the additional evidence of the presence in the immediate vicinity of numerous pieces of meteoric iron, some 25 or 30 pieces of which are in the American Museum collection of meteorites.

A fairly recent occurrence

The age of the Kaali Craters is young geologically. From the mixture of glacial drift and crushed dolomite in the material that fell back into the craters after the explosion, and from the fact that the elevated rims have not been disturbed, it is evident that they were surely formed after the last retreat of

the continental glacier. The large forest trees inside the main crater and on top of the rim certainly put the date of origin back a few hundred years. Considering all the evidence, it seems that the age of the craters may be as great as two thousand years.

Bearing also on the question of age, is the finding in Crater No. 4, of fragments of shells of land-snails of species that live today on the bushes in the vicinity. These broken shells were located in pockets, covered with the glacial drift and crushed dolomite, which fell back at the time of the explosion, and they remind one of the finding of shells of water-snails of recent species in the lacustrine deposits in the bottom of Meteor Crater in Arizona.

Not only did I have the opportunity of seeing practically all of this absorbing evidence under the direction of Reinvald, but I have also drawn heavily on his papers* in writing this account.

Specimens

I have brought back with me a complete series of specimens illustrating the phenomena described above, which were collected in my presence by Reinvald and presented by him to the American Museum of Natural History. These will be added to the Museum collection of meteorites now installed in the Hayden Planetarium building.

Not only am I personally grateful to him for his unfailing courtesy, but I wish also to recognize the debt which science owes to this well-trained and cautious worker for pursuing his research with such devotion. The Ministry of Trade and Industry has not been interested to invest money in the research since the initial exploration in 1927, because there was no hope of economic returns. Engineer Reinvald has therefore carried on his careful investigation of Crater No. 4, which has yielded such unique and important results, at his own personal expense, without the hope of pecuniary reward. He has added much to our knowledge of this fascinating type of nature's phenomena.

*"Bericht über geologische Untersuchungen am Kaali järv (Krater von Sall) auf Osel," von I. Reinvald. Publications of the Geological Institution of the University of Tartu, No. 11, 1928.

"Kaali Järv—The Meteorite Craters on the Island of Osel (Estonia)," by J. A. Reinvald. Publications of the Geological Institution of the University of Tartu, 1933.

The Meteor Craters in Estonia

Photographs of scars left on the landscape when a cluster of meteoric fragments struck the earth

By CLYDE FISHER



KAALI JÄRV OR MAIN CRATER: *View from peasant's clover-field showing nearly all of the largest crater of the group, overgrown with trees and shrubs—from the outside resembling a bit of virgin forest. One would hardly suspect the presence within of a meteor crater*



(Above) THE MAIN CRATER as seen from the inner slope of the rim, showing the circular lake (järv). The forest trees grow down to the edge of the water

(Below) Another view of the circular lake (Kaali Järv) which is nearly two hundred feet in diameter





(Left) "LOVER'S LANE": Shady foot-path extending clear around the top of the circular rim of the Main Crater (Kaali Järv), a favorite visiting-place for the peasants on Sundays and holidays

(Below) INNER SLOPE OF RIM of the Main Crater (Kaali Järv) the top of which is about 25 feet higher than the surrounding fields, and nearly 50 above the central lake. This rim is composed of a mixture of glacial drift and debris of the bed-rock



(Below) TILTED DOLOMITE STRATA which jut out from the upper part of the interior wall of the Main Crater (Kaali Järv). Engineer I. Reinvald, Inspector of Mines for Estonia in the foreground



(Right) CRATER NUMBER TWO:
One of the smaller of the six
meteor craters, overgrown with
trees and shrubs, and like the
others surrounded by level farm-
ing land



(Below) CRATER NUMBER
TWO: Engineer Reinvald stand-
ing on the floor of Crater No.
Two. On the slope at the left
of the picture may be seen his
excavations



(Below) THE FOOT-PRINT OF A
METEORITE: Bottom of Crater No.
Four, showing funnel of impact
of meteorite, which so far appears
to be the only one explored in the
world



Stardust

November's celestial "fireworks"—The Leonid showers, an annual bombardment from outer space which would demolish our cities if it were not for the protection of the atmosphere

By HUBERT J. BERNHARD

PRESENT hopes for communicating with other planets in the solar system are slim—but we are constantly receiving solid messengers from outer space.

On certain November mornings thousands of them—in the form of shooting stars—shower down into the earth's atmosphere. They are part of a large group of meteors traveling together in space, and as the earth, speeding at eighteen miles a second, shoots into the region they occupy, it attracts to itself many of the smaller bodies.

Pulled out of their accustomed paths by the earth's gravitation, they hurtle downward at speeds varying from seven to forty-four miles a second. They are chunks of iron or stone, ranging in size from a grain of sand to a large house, and they are cold with the absolute cold of outer space.

Become white hot

Then, suddenly, they come into the earth's atmosphere and their whole nature changes. As they rush through the thin upper air, their surfaces become warmed by friction. Quickly the warmth increases until the meteors are raised to red heat, then to white heat. They burn with a white glare and give off gases. Part of each one, unburnable, floats softly to the ground in the form of a fine ash.

By the time they have come within fifty miles of the earth's surface all but a few have vanished. They have burned themselves out in their mad, aimless dash through the air.

And the Leonid meteor shower is over for another year.

About 20,000,000 meteors, similar to these Leonids, hit the earth's atmosphere each day in a ceaseless and aimless bombardment from the depths of the universe. Few are visible, for they fall during the day, and in isolated places where there is no one to see them. But the careful observer, who sees only five an hour on average nights, occasionally enjoys a superb treat.

A quarter-million shooting stars

Little more than a hundred years ago, in November, 1833, the same group of Leonid meteors that still visits the earth appeared in the most awesome sky phenomenon yet recorded. At one station alone a quarter-million of these shooting stars were seen to dash to destruction between midnight and dawn.

Such spectacular displays are found to return at more or less regular intervals, and that of 1833 reappears three times a century. Never have the meteors streaked through the night sky in such numbers as they did a hundred years ago, but always they return.

The great shower of 1833 was not the first of the series known as the Leonids. Historical research shows that this group of meteors has been returning to the earth for at least 1300 years. The earliest account of them is the following, from an Arabian writer:

"In the year 599, on the last day of Moharren, stars shot hither and thither, and flew against each other like a swarm of locusts; people were thrown into consternation and made supplication to the Most High; there was never the like seen except on the coming of the messenger of God; on whom be benediction and peace."

The first well-described shower of this group occurred on November 12, 1799, and it was seen by Von Humboldt, a well known scientist and traveler who was then in the Andes. For four hours, he said, thousands of bolides and shooting stars were seen to dart across the eastern sky from north to south. There was no spot in the sky as wide as three full moons that was not full of them. They all dragged trains eight or ten degrees long, which lasted seven or eight seconds. Some looked as big as Jupiter, some showered sparks, some burst. Some, as big to the eye as the moon or half again as big, vanished without sparks but had trains half or two-thirds the apparent width of the moon.

Astronomers noted, during the 1833 appearance, what Von Humboldt apparently missed in the earlier show; that the meteors appeared to be emanating from the constellation of Leo. It so happened that if the paths of the meteors were marked on a star map and traced backward, one would find that they all crossed in that constellation.

From the "vanishing point"

This really is due to the same familiar perspective effect that makes railroad tracks appear to come together in the distance. Those lines are parallel, and geometry tells us that parallel lines meet at a point in infinity; artists call it the vanishing point. The meteors of any particular shower travel through the air in parallel lines, and as these lines seem to come toward the observer, he gets the same converging effect that he would if he were to stand between a set of railroad tracks.

The spot in the heavens at which these lines appear to cross is called the radiant of the meteor swarm and the shower usually takes its name from the star group in or near which the radiant lies.

When this convergent effect had been noted in the 1833 shower, astronomers studied records of the display in 1799 and decided that both showers were related. They predicted another for 1867, a shower that actually fell a year earlier.

The discovery that these great meteoric displays were part of a series led to the deduction that minor displays seen at other times were parts of other, less spectacular, series. Such is the case, and today we find available a list of

fifteen more or less well-defined showers which recur annually. Although the big shower of Leonids is seen only twice in a normal lifetime, there is a very much smaller display at the same time every year.

Investigation shows that these meteor swarms travel along orbits that are identical with the orbits of different comets. For instance, the orbit of the Lyrid meteors is the same as that for the comet of 1861, and a meteor swarm appeared to replace the famous Biela's comet. The Leonids, it is believed, came from Tempel's Comet. A list has been prepared to show seventy-six meteor streams whose orbits agree fairly well with the orbits of an equal number of comets.

While some of these comets are still in existence, many of them are extinct, and this fact gives rise to the thought that, as one astronomer put it, "Our periodic meteors may be the debris of ancient but now disintegrated comets whose material has become distributed around their orbits."

It appears likely that this is the case. These meteor swarms are distributed about the orbits in a peculiar manner. There is a main group consisting of millions of meteors bunched together in a loosely connected mass, and all along the orbit are other meteors, distributed in a long stream that usually covers the entire path. It is when the earth cuts the main swarm that we have such a display as the Leonids of 1833, and it is when the earth cuts some other part of the orbit that we have the minor displays seen in "off" years.

When they are in their normal state, out in space, meteors are not visible to terrestrial observers. They can be seen for only a brief moment, in their hour of doom, when they race through the atmosphere leaving glowing gases and ash in their wake. Often meteors have trains behind them which last from one second or less in most cases to the exceptional instances when they are visible for hours.

Some spectacular meteors

In their brilliant flight these shooting stars are sometimes very startling. In December, 1876, a blazing ball of fire swept across the United States from Kansas to Pennsylvania, being sighted at eleven different stations. There are records buried in dusty files that tell of exploding meteors—fire-balls—which

arrived during the night and burst with such an explosion that they awoke entire cities.

Sometimes they come during the day, and are so bright that they may be seen despite the sun. One, years ago, burst over Madrid, Spain, with such a noise that the crack of its explosion broke windowpanes in houses.

Two years ago airmail pilot Bill Coyle, of the Transcontinental and Western Air Lines, watched a brilliant meteor "big as the Wichita hangar" flash across the sky and leave a train that endured until daylight.

He was cruising about two miles above the town of Adrian, Texas, when he was surprised by what he at first thought was a giant floodlight turned on in the sky. It was a great meteor, coming out of the northeast and traveling west by southwest.

"In a second or two," Coyle said, describing the incident, "it became too bright for me. We were at about the same altitude. In a moment I caught sight of its tail and could tell it was going north of me. Its line of flight was probably forty or fifty miles distant; at any rate it was so close I could see fragments of the meteor whirling away from it and dropping back into the tail. It left a deep red trail with a bluish tint which hung in the sky until daylight."

This particular meteor disappeared in a thunder-like rumble that shook the ground in several states.

Visible over wide area

It seared the skies of northern Texas, New Mexico, and the Oklahoma panhandle, streaked over Colorado Springs, and was seen by residents of southwest Kansas.

Nor was Coyle's experience the only one of its kind on record. Even more recently another airplane pilot described a meteor which passed within fifty miles of him, and several spectacular ones have been seen from the ground.

When we consider that the effect of friction upon a meteor moving at the comparatively slow speed of one mile per second is the same as if it were standing still in a bath of red hot air, it is small wonder that the life of a shooting star is short. For the average meteor moves at a speed of from seven to forty-four miles a second when it is in the atmosphere, and the effect of the friction at this speed is to raise the meteor's temperature to one thousand times red heat.

This, then, explains why the average meteor is seen for only one second, appearing at a height of seventy-five miles and vanishing at fifty miles. Sometimes, however, they are so big that they are not completely consumed in their flight through the air, and they reach the ground.

Since the area of the earth that is inhabited by man is comparatively small, meteors usually fall in the vast expanses of the oceans or in uninhabited desert regions. There is no authentic record of one ever having hit and killed a human being, although one fell in Siberia in 1908, wiping out an entire herd of reindeer and laying waste fifty miles of forest.

Atmosphere protects cities

If the protection that the atmosphere affords from meteors were to be removed, millions of meteors falling each day would crash down on cities and hamlets; they would smash the majestic skyscrapers of New York into a smoldering pile of torn and twisted brick and steel.

This fact was called to the attention of New Yorkers in screaming headlines on the morning of March 14th when a brilliant fireball roared across the heavens from the southwest and vanished above the waters of the Atlantic Ocean. The sudden sight of the phenomenon so impressed editors in the slumbering city that one tabloid newspaper issued an inky Extra, and another paper stopped its presses for the story.

It is believed that the meteor first burst into sight not far from over Norristown, Pa., between 2:47 and 2:48 a. m. Traveling in a general easterly direction, it shot over part of Pennsylvania, cut across the middle of New Jersey, and disappeared off Sandy Hook. The distinct crack of an explosion was heard in Trenton, N. J., causing windowpanes in that city to crack in some instances and giving rise to a wild report that a nearby ammunition dump had exploded.

Far from the line of flight, the meteor was marked by a peculiar flash of bluish-green light, which lasted for an appreciable length of time. The writer, who was indoors at the moment, had his attention called to the "flash of lightning" by a companion, and although he had to turn about to look through a window the light still lingered in the sky.

Eight startled passengers in a northbound airliner soaring through the night over Virginia saw the strange light and watched the yellowish-red mass hiss through the air far ahead. Even as the co-pilot radioed a query to his home office, the fireball was sighted by several ships at sea. At Newark airport, central air terminal of the east, the flash of the meteor was so brilliant that it outshone the floodlights on the landing field.

Reports received at the Flower Observatory in Upper Darby, Pa., show that the meteor was sighted from at least six states and the District of Columbia. Approximately 200 persons recorded the phenomenon, and the states represented were, in order: Virginia, Maryland, Delaware, Pennsylvania, New Jersey, and New York.

Dr. Charles P. Olivier, director of the Flower Observatory and a well-known authority on meteors, reports several competent witnesses as saying that, during the latter part of its path, the meteor itself was brighter than the full moon. Although there is no reasonable way of giving the mass of the meteor with exactness, Dr. Olivier ventures a *guess*, based on the phenomena of sound as well as the object's brightness, that it was at least 50 pounds in weight. It is possible that it may have been several times as heavy as this, but it is most unlikely that it weighed a ton, even as it entered the atmosphere.

Some reports received at the observatory stated that the meteor was seen actually to fall in the water. However, it did not remain brilliant to distant observers until it actually hit, as might have been expected. Its "disappearing point" therefore was some miles high, and the exact figure remains to be computed.

Heat superficial

Those meteors that do land reveal several inconsistent characteristics. After their violent flight through the air, it is only natural to expect that they would be at least red hot when they land, but this is not so. On one occasion a meteor, seen to land on a pile of straw, was picked up a few minutes later and found to be cold to the touch. It had hardly crushed the straw upon which it rested.

Although such a happening as this may seem impossible, the explanation is fairly simple. The meteor's temperature as it hurtles

through the air is extremely high, as we have seen, but when it is free in outer space the stone is unbelievably cold—probably close to the absolute zero of -273°C .

The heating effect of the atmosphere is limited to the object's surface, which burns and floats away as ash while the newly revealed surface is heated in turn. The interior of the meteor remains at its original low temperature, and only a very narrow layer of the surface is heated. Thus, when it lands, the stone can cool very quickly.

Some meteors bury themselves far below the surface of the earth, while others simply drop on the ground. One meteor, weighing 647 pounds, fell in Hungary, and ploughed into the earth to a depth of eleven feet. On the other hand, Peary's $36\frac{1}{2}$ -ton Cape York meteorite, now housed in the Hayden Planetarium, was found only partly buried. The deeply pitted $15\frac{1}{2}$ -ton Willamette meteorite, also in the Planetarium, and the 20-ton Bacubirito stone were not deeply buried, but a 437-pound fragment fell in Iowa and dug eight feet into stiff clay.

Possible origin

In experimenting with meteorites, scientists have found further proof of their contention that these stones are the remains of comets. By placing specimens in a vacuum, heating them, and comparing their light with that of comets by means of a spectroscope, it becomes apparent that the spectra of meteors and comets are similar.

But a still more interesting series of experiments upon meteorites was made by Dr. Charles P. Lipman, of the University of California. After taking extreme care in sterilizing his instruments, Doctor Lipman obtained results which he believes prove that some meteors actually carry in their interiors spore forms of certain bacteria. He has isolated specimens which seem to be in an early stage of evolution similar to that through which some of the common bacteria of the earth passed millions of years ago.

If the discoveries of other biologists should prove Doctor Lipman's theory correct, this obscure experiment may prove one of the most significant findings in modern science, for it may answer the age-old question, "Whence came life on the earth?"

Bark Cloth from Africa

Profile of a primitive clothier. His hands transform rough bark into cloth that rivals the product of our modern looms

By LUCY POPE CULLEN

“TOMORROW,” said Mofia, “I will make a piece of bark cloth for Mama.”

When I had rallied somewhat from the shock of being called “Mama” by a patriarch who remembered the Angoni Wars of the last century, and who had personally seen Doctor Livingstone, I replied politely:

“Mutende, Mofia!”

“Mutende” is an extremely useful word in the bush country of Northern Rhodesia. It has no very definite English translation, but is used to express greetings, thanks, approval, encouragement, cordiality; in fact all of the more social emotions. Even if you can’t say anything else in the local African languages, this one remark will take you a long way, because it shows any native that you meet that you have been well brought up and that your intentions are good. When you have learned to clap your hands, as if applauding, and to nod your head in unison with the clapping, you are well on the way to becoming really at home in the Northern Rhodesian bush.

When I had clapped, nodded and said, “Mutende, Mofia,” Mofia clapped, nodded and said, “Mutende, Mama.” Mine meant, “Thank you, it is very kind of you to offer to make me a piece of bark cloth,” and his meant, “Not at all; it will be a pleasure!”

Beyond civilization

Mofia is a member of the Lala Tribe of northwestern Northern Rhodesia. My husband and I were in the Lala country on one of our periodic camping trips. We lived at the Roan Antelope Copper Mines, just below the

Northern Rhodesia-Belgian Congo border. We often spent our holidays driving through the surrounding bush; camping and making side excursions on foot or by mashila. We found it the best way to see something of the native life of the territory. There were eleven thousand natives living at the Roan Antelope mine, but seeing them there was not at all the same thing as seeing them in their natural environment. When they come to a European community to work, they quickly don European clothes, including horn-rimmed spectacles; they buy bicycles and gramophones, cooking utensils and farm implements. They play football and go to moving picture shows. Their children become Boy Scouts, Girl Guides and golf caddies.

To get away from what is popularly known as civilization, it is, therefore, necessary to strike out into the bush, away from the main roads and the European towns. Since Northern Rhodesia has an area of 287,950 square miles, with a European population of about twelve thousand and a native population of over a million, this can be done fairly easily.

We tarry

When we came upon Mofia’s village during one of our rambles, we intended to exchange a piece of the antelope we had shot for some eggs, and then to go right on. So cordial and friendly were the villagers, however, and so thoroughly had we ourselves fallen into the leisurely ways of the country, that we ended by pitching camp nearby and staying several days. It was a tiny community of only about 150 people. I call it “Mofia’s village” because he was its Headman, acting as general supervisor of manners and morals and settling dis-

putes among the others. Mofia was also the official maker of bark cloth. His father and his grandfather had made it before him, and he took great pride in the family craft.

Back in the little bush villages life goes on much as it has for hundreds of years past. The people dress almost exclusively in bark cloth; they make practically everything that they use. There is in each community a blacksmith, a potter, a mat weaver, a basket weaver and a bark cloth maker.

The right tree

On the morning following his offer to make a piece for me, we went to the village to watch him do the work. The first step was to find a suitable tree. Accompanied by most of the village, we walked for some distance through the bush, passing, of course, thousands of trees en route. Most of these Mofia ignored entirely; though he paused occasionally to break off a twig and bite it, or to crush a leaf in his hand. Each time he muttered a few words to himself, shook his head and passed on. In the interests of general information I asked what sort of tree he was looking for. There were, Mofia informed me, many sorts that could be used, but the particular tree had to be of the right age.

"What age?" I inquired, still hopefully pursuing knowledge; though the five years I had already spent in Northern Rhodesia should have taught me better.

"Not too old, Mama," replied Mofia, looking pained that I should have to have such an obvious point explained, "and not too young."

The final selection was a Musamba tree, which measured about eight inches in diameter. Mofia had brought along an adze made in the village forge. With this he felled the tree, chopped off a three-foot section and cleaned it of its rough outer bark. Slitting the exposed white layer of bark from end to end, he hammered it briskly to loosen it and then pulled it from the log in a single piece, about a quarter of an inch thick. Holding this upright with one hand, he shaved it with the adze down to about an eighth of an inch. So skilfully did he wield his crude little implement that the shaved bark was as smooth as if it had been planed. It was now placed in water to soak until the next day.

Mofia, it should be noted, was at least eighty years old; probably more. An African

of his generation seldom knows his exact age; he tells you how tall he was or how many children he had when a certain event took place. Mofia's oldest child, he told us, was almost shoulder high when Livingstone died. Yet all the time he worked on the bark, this octogenarian squatted on his haunches on the ground, his back erect and his knees flat against his chest. It is an attitude that few adult Europeans can maintain for more than a minute at a stretch—granting that they can assume it at all, which is highly doubtful. Mofia rose from several hours of this jack-knife posture in a single motion, without even putting his hand to the ground to help himself up. As I creaked slowly to my own feet, the thought occurred to me that perhaps "Mama" wasn't such an unsuitable name for him to call me, after all.

Bark to cloth

When he took the bark out of the water next morning it had turned a dark, reddish brown, and was pulpy and soft to the touch. Now came the most important part of the job, and the one whose execution draws the line between the expert and the amateur maker of bark cloth. Resuming the jack-knife posture, Mofia spread the bark out on a log, and began to tap it gently all over. The implement used was shaped like a hatchet, but had a blunt, double edge. The whole surface of the cloth had to be tapped twice, the second time cross-wise of the first. A false stroke would, of course, have made a hole in the soggy material. It took Mofia three hours, but he did not miss a fraction of an inch of the surface; nor did he once cut through it.

The whole village sat with us to watch him do the tapping. Mofia, evidently feeling his responsibilities as host, told us a number of stories as he worked. The natives in these villages spend a great deal of time simply sitting in the shade carrying on endless conversation and telling endless stories. Of course everyone knows the stories but this never dulls their enjoyment. Each listener chips in with details and embellishments that the narrator omits. A single story with the most elementary plot can be made to last for hours, and it usually does. Time means little anywhere in Africa; and in such a village means nothing at all.

The villagers as usual were thoroughly familiar with Mofia's stories, and supplied

the usual Greek chorus effect. It is impossible for an African to do anything without falling into rhythm; Mofia's tapping accompanied his soft, sing-song voice like the beat of a small tom-tom. The tale that stands out most distinctly in my memory was related as an actual experience of Mofia's:

To the land of the dead

He died once, Mofia said, and went to "M'bonshi," or Spiritland. After two days during which he was greatly embarrassed because nobody took the slightest notice of him, a disembodied but awful voice suddenly called his name. So frightening was it to hear this voice coming from nowhere and yet from everywhere at once, that Mofia fell down flat on his face. The voice said that Mofia's presence in Spiritland was a mistake; that he had not been called yet, and that he would have to go back to earth and wait for his call to come.

He is waiting now, he said, but next time he goes to Spiritland nothing will surprise him, for he knows just what it is like. He described it as a vast place with huge stones piled on top of one another. The best part of it was that he saw in Spiritland every kind of antelope in the world. There were all that he knew, and a lot that he had never seen before. The villagers chimed in here to help him name the various antelope; they evidently loved this part of the story, and lingered over it as long as possible. White teeth flashed in black faces, eyes shone, the tapping accelerated and became gay. Spiritland, with all those antelope, was plainly going to be a very happy hunting ground indeed.

Spiritland, went on Mofia more soberly, after they had finished with the antelope, was divided into two parts; if you get into the second part you never come back. He, of course, was only in the first. He saw some of his dead friends, notably his own father, looking at him from the second part, but was unable to communicate with him.

"There I was," said Mofia, tapping sadly now, as the villagers murmured and shook their heads in sympathy, "like a noodle, where I wasn't wanted, and I could not even speak to my old father!"

The clinching proof that the place was indeed Spiritland lay in the fact that Mofia's father was dressed in the very piece of bark cloth in which he, Mofia, had wrapped him

for burial when he died. The shock of the whole experience was so great that for some time after Mofia returned to earth he could not talk properly, but could only gurgle like water coming out of a bottle, to judge by the joint demonstration with which he and the villagers concluded the narrative. So obviously convinced were they all of its entire reality, that we could only listen in respectful silence, and surmise that he had suffered delirium, or perhaps had a vivid dream.

By the time the story had reached its end, the bark cloth had been tapped sufficiently. Stretching was the next step; this was done by twisting it as you wring a towel and pulling it at both ends. It stretched amazingly; when it was finally untwisted it was at least four times the size of the original piece of bark. It was then oiled, to toughen and preserve it. Castor oil beans, grown in the village, had been boiled up into an exceedingly evil-looking, dark gray mess, which Mofia intrepidly scooped up with his hand and patted over the surface of the cloth. The oil-soaked material was finally dried for several hours in the sun.

When it was quite finished, Mofia brought it over to where I was sitting and laid it on the ground at my feet.

"Mutende, Mofia," I said, "It is beautiful. Mutende!"

"Mutende, Mama," said Mofia, smiling as he clapped and nodded.

"Mutende, Mama," echoed the faithful villagers.

A memento

While it was a little stiff at first, the cloth has limbered up until it is as soft as a wool blanket. The marks of the tapping give it the exact texture of a woven material. It is remarkably strong and durable; the friends to whom we show it can seldom resist the impulse to see if they can tear it. So far no one has succeeded. It exudes a pleasant, woody odor, rather like that of a cedar chest.

It is not, however, these virtues that make the cloth one of my most cherished possessions. In its brown folds are memories of a tiny village far out in the African bush, and of a slow, easy-going way of life; of a circle of happy, absorbed faces surrounding an old man, squatting on the ground, tapping rhythmically and telling of the antelope in Spiritland. The cloth is like a piece of Africa itself.



Bark Cloth from Africa

THE MAN who knew Livingstone: Mofia, venerable patriarch of a drowsy African village, supervisor of the manners and morals of 150 natives clothed almost entirely in Bark Cloth

All Photos by A. Douglas Cullen



(Above) MOFIA'S RAW MATERIAL: Chipping away the rough outer bark with an adze made in the village forge. At least eighty years old, Mofia can work in this jackknife-like position for several hours



(Above) LOOSENED BY BRISK HAMMERING, the bark is pulled off the log in a single piece by the skilled hand of the primitive craftsman



(Above) SHAVING DOWN to an eighth of an inch. No carpenter's plane excels the home-made adze when manipulated by Mofia



(Above) BARK CLOTH, NOT TAFFY: Mofia and assistant stretching the cloth after it has been soaked in water then pounded with a hammer to the rhythm of Mofia's tales of the spirit land



(Above) UNTWISTED, the cloth has stretched to four times the original length. Now, Mofia can add the finishing touches



(Above) CASTOR OIL FOR "TANNING": Mofia softening his handiwork with a native fluid brewed from castor beans



(Above) SEWING CALMLY in a land where time means nothing: Mofia's thread is a strand of bark, his needle a product of the village forge



(Right) HIS JOB COMPLETED Mofia gets a "lift." The cigarette is a section of reed, filled with tobacco

More Fun with Sharks

*The crowning episodes of a shark fisher's long experience—
encounters with the voracious Tiger Shark, in Bahaman waters*

By COLONEL HUGH D. WISE
U. S. Army, Retired

STUDY had verified for me the tradition that the waters of the West Indies are the habitat of sharks in great numbers, of many species of unusual size and ferocity, and I was anxious to have a try at them with rod and reel. Through Mr. H. S. Mazet, co-author with Captain Young of a recent book, *Shark! Shark!*, I met Mr. Gillette, President of the National Fisheries Corporation, a commercial company engaged in shark-fishing, and I was soon in correspondence with the resident manager of the company at Nassau, Mr. E. M. Schuetz. Him I found to be not only thoroughly informed as to sharks but also to be a sportsman, ready to help us with the preparation of the little expedition which I was planning.

I think, however, that Schuetz was a little nonplussed at the idea of fishing for sharks as sport-fish with rod and reel. Nevertheless, he got my idea and he thought that the Bahaman Tigers would give me all the fight I was looking for. "Tiger Shark!" The very name sends cold chills through the marrow of a Carib and pictures to the shark-hunter the great brute which it so well describes.

Tigers abundant

Schuetz reported them large, savage, and abundant. A letter from him told of the return of one of his parties with fifty-one sharks; thirty-one of them Tigers, two fourteen-footers and one sixteen-footer. That letter settled me—I was going! A sixteen-foot Tiger would weigh upwards of a ton and could not

be held on a rod, but what fun trying to do it! The ten-footers, weighing six or seven hundred pounds, could be handled.

News went to Schuetz that we were coming and he began looking up a boat for us.

My son, Hugh, is as keen a sportsman, or should I say "fishing crank," as is his father. My son, John, a Princeton undergraduate, is deeply interested in biology and zoölogy, and since Professor Dahlgren, of the Biology Department, Princeton University, a fishing companion of mine, could not go with us, John had to be our biologist, but Dahlgren wrote a letter bespeaking for us interest and help. J. Victor Coty, the lecturer on fishing and an expert movie cameraman, joined us to take movies of the sport, undeterred by his experience in roughing it with Dahlgren and me before.

Season

People who are unfamiliar with the tropics invariably have exaggerated ideas of the heat, so we were the recipients of the usual criticism for having selected summer as the time to visit Nassau. Had we wished to do so, we could not have avoided this, because we were after sharks and midsummer is the best season for them, and later in the year hurricanes make being out in a small boat impracticable. As a matter of fact, however, the heat in Nassau is no worse than that of midsummer in New York and the thick-walled, high-ceilinged houses with broad shaded verandas surrounded by palm trees make it endurable. Sitting in the shade of palms, fanned by ocean breezes, and sipping a Planter's Punch, one can really pity people at home.

June 16th our party, equipped with eight

rods, miles of line, and dozens of hooks and leaders; harpoons, harness, and tackle-boxes; silk nets and bottles of formaldehyde for the biologist; endless paraphernalia for the photographer, and, incidentally, some clothing; embarked on the *Munargo* at New York. Bound on such an expedition, we were naturally more or less curiosities to other passengers but their interest in our doings was rather surprising. On the passage we were kept busy answering questions like: "How big are sharks? Do they really attack boats? Do they eat men?" One young man was nervous about them on bathing-beaches and wanted to know if there was much danger from sharks in the water at Coney Island. "Not as much," I replied, "as there is from rusty old tin cans, but *bottles* are probably the greatest danger there."

"Suppose a shark jumps into your boat?" asked one girl, in perfect seriousness.

"Then," said I, "I should write an article, for that would be news."

Swimmers among sharks

Two and a half days out from New York we slid into the amethyst Harbor of Nassau to be greeted by a score of dinghies each laden with chattering, shouting, native boys who howled that coins be tossed for them to dive after. Now, these waters are infested with sharks but the boys are never hurt by them. They are really in no danger from sharks because the shark, is, in fact, a timid creature which keeps away from such commotion as is going on. If the sharks were chummed up and excited by the scent of food or blood, these boys would not last long, but as it is they have little to fear. I would readily insure them for a very small premium but I would not go in there with them for a considerable sum. There you have one of those anomalies which apparently attach to most shark lore. The government seems to recognize the element of safety in the noise and crowd of the harbor, for it forbids these diving boys to ply their trade outside.

For some inexplicable reason, sharks are particularly suspicious of dark objects while light-colored ones seem to attract them. They will take, as bait, a skinned fish in preference to a fish with dark hide and they seem to prefer whitish fish rather than dark ones. This is strange, because darkish skates and rays are

their favorite natural food; these, however, are light underneath.

A striking example of the attractiveness of light objects to sharks is told by Captain William Young who says that one day when towing a dead black horse to attract sharks, a shark followed but would not come within harpoon range. When a newspaper was thrown overboard, however, its white flash caused the shark to dash up and he was harpooned.

Camouflage

Captain Young, in his wide experience with sharks, intimates also that this peculiarity makes the negroes of the West Indies more immune from shark attack than white men. He tells how native divers smear their white palms and soles with tar, but one scientist believes that the protection is due to the fact that sharks do not like the smell of tar and that even the smell of marlin will keep them from a bait. Quite opposed to this theory, Mr. Schuetz uses tar liberally on his equipment. The buoy and anchor lines of his nets are of steamed tarred rope, and bait is tied to the meshes with tarred marlin, all of which does not seem to discourage the sharks. On the other hand, Schuetz absolutely confirms the idea that sharks are attracted by light-colored objects and for that reason he has, after experiment, adopted white nets which he has found to be superior to those of the various colors tried, or to nets camouflaged to resemble the bottom. In my own experience, I have noticed no advantage in any color of line, white, green or natural.

I mention all this to show how different are opinions as to the likes and dislikes of this fish.

While we hung over the rail watching these aquatics in which the prizes go immediately to the most efficient, Mr. Schuetz bustled aboard to meet us—clean-shaven, in a crisp linen suit and wearing a straw hat, the typical businessman of the tropics. He was so bubbling over with interest and so generous with his help that, after thanking him for what he had already done, I could not resist asking why he was so good. "Because," said he, "I am a sportsman and I like to help other sportsmen," and certainly, while we were in the Bahamas, he lived up to that ideal.

Tackle and equipment unloaded, Hugh and I went across the dock to look over the boats

that Schuetz was holding tentatively for us and selected the *Malolo B.*, a thirty-nine-foot modified "sea-skiff." She was sound, clean, and well-engined; there were bunks for four, galley, toilet, and facilities for food and ice storage. Aft there was a roomy cockpit and two swivel chairs. What appealed to me immediately was that the helmsman's wheel, in easy reach of all controls, was forward of the chairs but in plain view of them. There were some details about the boat which might have been better, for example: there was no hoisting crane for taking aboard big fish, but all in all, she was surprisingly well suited to our purposes, and it must be remembered that our demands were unusual.

No one at Nassau had ever seen sharks angled for with rod and reel and the ideas of John and Coty had never risen above the local horizon. Altogether, we were undoubtedly pioneers but the natives probably regarded us as a bunch of "nuts." At first the boatmen, though politely humoring us, clearly could not understand, and Schuetz alone seemed to get the idea.

Life in Nassau

When one steps ashore in Nassau, he is at once impressed with the ease and comfort which the population, mainly black, enjoys.

As in other British colonies, the streets are clean, but how narrow they are! Cars pass cautiously, and at corners they must stop and honk before turning. One never knows what he may meet around a corner—a bicycle, a donkey-cart, or a wheeled sponge-crate, and all vehicles keep to the left of the road, thus adding to the American's confusion. Horse-drawn surreys are still a popular means of transportation in Nassau, so when Hugh and I had finished our arrangements at the boat we chartered a surrey to take us to the hotel, but when the poor old horse could not pull us up the hill, the driver descended from the box and pulled with him.

With its abundance of tropical foliage Nassau is quaintly and exotically attractive. Sponge marketing, the most important industry, is interesting, though drab in color; but another, grass-weaving, fills the street markets with pretty baskets and bright colored hats, which are urged by the native women vendors on the visitor. Our party purchased some of these, but was saved from buying hun-

dreds of them only by the greatest self-denial. Hugh's photographs show him fishing under the shade of a gaudy headgear which was evidently intended for a black Nassau belle.

We were there, of course, out of season, so most of the big hotels were closed, and we made our headquarters at the old Royal Victoria which, with flagstone terraces, wide balconies, its general rambling design, and total disregard of space, is distinctly tropical.

Departure at dawn

During the day Schuetz had given us all possible instructions and mainly on his advice we decided to start our shark hunt at Andros Island. After dinner at the hotel Hugh and I went aboard ready to sail at daylight, the boat, equipment, and tackle all checked and the charts studied.

Nothing could have been more propitious than our start at dawn on that beautiful morning. Out of the placid harbor, our engine purring rhythmically, we glided onto a gentle rolling sea. Green palms fringing the coral shore nodded farewell in the gentle breeze, and houses pink in the rising sunlight blinked good luck.

Those broad inland waterways between the Bahaman Islands surpass all description, for, exquisite as are the pastel tints along the shores, still more beautiful are the shades of blue and green separated from them by the line of feathery, foaming white breakers, and, over all, great drifting masses of cumuli, glistening white, silver, rose and gold beneath an azure sky. The breath of early sunlit morning is in the breeze which soothes the temples, the tang of the sea is in the spray which feels good on face and tastes good on lips. The very bound of the boat seems to lift one's soul above all that is of the drab land.

Bearing away from New Providence Island, land sinks from view beneath a rolling sea which now in full daylight takes on in one direction the deep blue of the Mediterranean and, in another, the brilliant green of the Chesapeake.

Poets and artists would stop the engine to lie here and drink in all this loveliness, but we are only fishermen so we open the throttle and drive on toward the sport of which we have been dreaming. Southwest we head, fifty miles to Andros Island, the former rendezvous

of famous pirates and still the habitat of giant sharks, swashbucklers of the sea as blood-thirsty and as relentless as were Morgan and Blackbeard.

Barracuda as bait

At noon we slowed down off High Cay to troll for bait, but this is not the drudgery one might think it to be, for the bait was barracuda and that big game-fish is itself well worth coming for. Not to miss any of the sport, we used our light tarpon rods and made the most of the fights.

Barracuda are as savage as sharks and as relentless in the toll they take of other fish. About the only thing in the sea which they will not attack is the shark, for about the only thing they cannot tear with their terrible spiked teeth is the denticled hide of a shark. The barracuda is really more to be feared than the shark because he can and does frequent the shallow waters of bathing beaches where deaths and injuries inflicted by the barracuda far exceed those inflicted by the shark who is blamed for many of them.

Hardly were our lines out when a big barracuda struck and sizzled off two hundred yards of Hugh's line in a glorious run. Then my reel shrieked and a big barracuda took out two-thirds of my line before I checked him. In about ten minutes I had him coming and within a hundred yards of the boat, when a shout went up—"There's a shark after him!" The barracuda leaped and came down into the white surge which followed him, an added strain came on my twelve-thread line and my rod bent into a semi-circle. Then the line slackened and I wound in a barracuda's head, the shark having kept the rest of the fish as his share. It must have been a Mackerel Shark because we were trolling at about five miles an hour and other sharks rarely strike at such trolling speed.

One of the barracudas we caught was such a beautiful specimen that Burt, the Carib boatman, looking at him, remarked—"He looks good enough to eat."

"Certainly," I replied, "we will eat him tonight."

"No!" shouted he and the captain in horrid chorus, "He's poisonous!"

I had always thought that fish-poisoning was entirely due to the ptomaines of partial decomposition and knowing that this fish was

fresh, I attributed their protest to native superstition, but I humored them and we did not eat the barracuda. Later inquiry proved, however, that this belief was general in the Bahamas, so on my return to New York, I reported it to Doctor Gudger of the American Museum and then I learned how ignorant I had been, for in the West Indies there is a well-known disease, *Ciguatera*, caused by the eating of certain fish, among them barracudas, whose flesh, particularly in the breeding season, may be impregnated with toxic secretions.*

With enough bait, and having had great sport getting it, we dropped over to the shark grounds in the channel, slowing down to lay a slick as we drew near.

A fin

I was first in the chair, and Burt put half a barracuda on my hook. Before we came to a stop and while Burt still stood holding my baited hook in his hand, a big fin came up in the streak twenty-five yards astern. "Throw it!" I yelled and "Plop!" it hit the water a few yards in front of the fin. A swirl—a rush—he had it! I struck, and out went the line with the high pitched whine of the reel while Hugh strapped me to the chair. We had a great fight, that shark and I, or rather I did, before his ugly Tiger mouth showed at the surface ten feet away about an hour later. It was Burt's first throw but he drove the dart deep just above the pectoral fin and as the lanyard whirled from the bucket, he gradually snubbed it around a cleat. Then the shark was hauled in.

When we came back to the slick I surrendered the chair to Hugh who immediately became engaged in battle with another three hundred-pound Tiger. He had a more difficult job than I had had, because we had anchored to hold against the tide and the anchor was down when he got his strike. We could not get it aboard, and dangling aweigh three fathoms below the bow, it seriously interfered with our maneuvering. Nevertheless Hugh brought his fish to iron in good style.

Each took several more sharks that day and we both had tired backs when we quit to make the anchorage before dark behind the reef at Mangrove Cay. We had come after Tigers and

*Gudger, Dr. E. W., *Poisonous Fishes and Fish Poisons*. Am. Mus. Nat'l History. *Am. Journal of Tropical Medicine*, Vol. 1, No. 1.

here they were. There was one slender fish of about fifty pounds which still showed the leopard spots characteristic of young Tiger Sharks. A second, weighing about three hundred pounds, had distinct tiger stripes on his sturdy body, and a third, about the same size but evidently older, was of uniform brownish-grey, showing indistinct stripes only near his tail. Both of the larger ones were vicious devils and when their blunt noses came up their big jaws, with cruel triangular serrate teeth, were snapping like bear traps and we understood the dread they inspired in the natives.

The presence of a party like ours in harbor at Mangrove Cay is quite an event, so I, who remained aboard while the others went ashore, received many callers who paddled out to satisfy their curiosity, and whom I energetically pumped to satisfy mine. When the shore party returned they brought some turtle meat, langousts, fresh fruit, and a gunny sack full of green coconuts, whose milk, that most refreshing of tropical drinks, served us well in the days to come.

An outpost village

Mangrove Cay is a native town of about twelve hundred inhabitants stretching in a single row of palm-thatched houses for nine miles along the shore. Mr. Forsythe, the British Commissioner, is, I believe, the only white man there but he seems to like it for he has been there twenty years. Mangrove Cay is his kingdom where he is ruler, counselor, friend, and advisor to all, in sickness and in health—one of those Englishmen who extend British influence more, perhaps, than it is carried by conquest.

The natives are a mixture of Carib and Negro, varying in type between the two. Some of them appear to be pure Carib, with thin nose, high cheekbones, straight hair and bronze skin while others are distinctly West Indian negroes. All of them impress the visitor by their kindliness and good humor even more than they surprise him by their ignorance. Their friendliness to us was demonstrated by their insistence upon a ball in our honor. Of course we were expected to pay the musicians—one of their popular songs carries the refrain, "Fine gal, take care of the rich man sailor."

Andros Island is some hundred miles long and forty wide, but very low. From natives

we heard of fresh water lakes in the interior in which were to be found sharks, barracuda and other pelagic fishes which, of course, may have been swept overland into them by great hurricane waves. The sharks are reputed to be of great size and ferocity, so fierce, the natives said, that the government had warned them to avoid those waters, but I am inclined to believe that such sharks, if or when there, are but trapped and temporary sojourners rather than permanent residents and that, sooner or later, they will succumb to these unusual conditions.*

The physiological processes of sharks are apparently not so well adapted to life in fresh water as are those of some other fishes, various teleosts for example. Certain small rays are known to live permanently in some fresh water rivers of South America, sharks do ascend the Ganges far above salt water, and sharks are found in the land-locked fresh water of Lake Nicaragua. There is considerable doubt, however, among scientists as to whether these Nicaragua sharks are a misidentified form of wanderer from the sea or whether they are a fresh water species.

After a number of highly exciting encounters with Tigers on June 23rd we had to run back to Nassau for ice and supplies, and a good night's rest in a comfortable bed would not be unacceptable. Also, I had picked up considerable native lore which I wished to discuss with men in whose opinions I had confidence.

A quick-change artist

One such notion was that a Nurse Shark, when attacked, could tighten his hide to resist the harpoon. Natives generally believed this, as also did the British Commissioner who thought it might be the origin of the native expression, "setting his skin," by which they imply a man's "preparation to resist." Mr. Schuetz, Captain Brown, and the crews of the shark-fishing tugs of the National Fisheries Corporation, all confirmed this and were willing to be so quoted.

Other sharks, too, may have this same capacity and experiments proved to me that a harpoon which would bounce from the hide of a live shark, as from a steel plate, could be

*Report of C. M. Breder, Jr. "Ecology of Fresh Water Lakes, Andros Island," N. Y. Zoological Society, Vol. XVIII, No. 3.

easily driven into it when the fish was dead.

The next year, Schuetz, on the basis of experiments and observations made by him, offered the following explanations: in the hide of a Nurse Shark, the denticles are set somewhat like hexagonal tiles in a bathroom floor, the tissues between them being like the cement between the tiles. When agitated or touched, the shark voluntarily or by a reflex action draws these "tiles" together so that even a harpoon point or a knife edge does not penetrate between them, thus "setting his skin" into a continuous sheet of resistant armor plate.

Attacks by sharks

I especially wished to check up on those lurid yarns about fights between man and shark in the shark's element—water.

There are reliable accounts of swimmers who have rescued others by frightening away the shark, such, for example, as the heroic saving of a man in Australia for which the rescuer was decorated by the King. Personally I have never believed that a man swimming could successfully fight a big shark with a knife. To drive a knife through the denticled hide would require tremendous power, and there would be small chance of its reaching one of the two vital and well-protected spots, heart or brain, even though the shark remained passive during the operations. Meantime, one slash with his teeth or one wallop with his tail would end the fight.

Though I have minimized probability of danger from shark attacks, yet I recognize that there are many well-authenticated instances in which sharks have attacked men and even boats.

Doctor Gudger has told me how at Key West his boat was attacked by a large wounded Tiger Shark who splintered the boat-stem with his strong teeth. Doctor C. F. Holder, in his book, relates similar experiences at Tortugas. Of course reports of such scientists are incontrovertible.

Mr. E. M. Schuetz has recorded his personal experiences in his diary, from which he allows me to quote these instances.

In May, 1934, in the Berry Islands, a large Tiger Shark, wounded by a harpoon, turned upon a ten-foot dory, seized its bow in his jaws and shook the boat so violently that its three occupants were thrown into its bottom. "We

were like ice in a cocktail shaker," said Schuetz. Such an experience, however, does not seem to have chilled Schuetz' enthusiasm for shark-hunting nor to have unsteadied his aim with the harpoon.

In June, 1933, at Gorda Cay, a Mackerel Shark which Schuetz was chasing, turned upon the dinghy and left some of his teeth in the keel. In the same month, a Yellow Shark, missed with the harpoon, seized the shaft in his teeth and bit it into three pieces.

To my mind, these incidents do not indicate aggressiveness on the part of the sharks but rather retaliation to attacks made upon them.

One of the most exciting experiences related to me by Schuetz was that of a large shark, who, when hooked on a hand-line, seized the rudder and then the propeller of the boat which he might have capsized had he not been cut loose.

Another of Schuetz' accounts seems to show not only the viciousness of a shark but also some degree of intelligence. While Schuetz was casting from a ledge, a large shark tried to swipe him off with its tail. Schuetz, dodging the tail, quit fishing and clambered up from the ledge, which shows, at least, that Schuetz had reasoning power.*

At Nassau the following story was widely circulated and I was able to interrogate several witnesses. Six men had been recently drowned from a capsized boat. The bodies lay at the bottom while sharks circled around but did not disturb them. When, however, the bodies began to be raised with grappling-hooks the sharks dashed in and tore them to pieces. It would seem that the semblance of life which movement gave them attracted the sharks.

If caught among sharks

The discussion of all this with experienced fishermen in Nassau led naturally to the old question of what a man should do if he found himself in the water with sharks near. All of us agreed that he should kick, splash, yell, and raise all possible commotion but none of us would wish to be held responsible for giving such advice. Frankly, under such circum-

*Further consideration of this incident, however, leads Schuetz to believe that the shark was really not swiping at him, but simply swung his tail out of water with a sudden turn when he was frightened by another man on the bank. What a pity to spoil such a good story.

stances, I should be willing to let the shark have the swimming hole and I would raise no question of riparian privilege.

The foregoing stories, received first-hand from men whose training and experience eliminate probability of excited exaggeration or hasty conclusions, can be taken as bases for deduction.

Davy Jones's surprise witness

A remarkable story, vouched for by the Secretary of the Institute of Jamaica and for which there seems to be documentary evidence, is that, in the 18th century the American privateer *Nancy* was seized by *H. M. S. Sparrow* in the Carribean Sea and her captain was taken to Port Royal for trial. Because of lack of evidence against him, the captain was about to be acquitted when the commander of *H. M. S. Abergavenny* came in with the ship's papers of the *Nancy* which had been thrown overboard but which the commander of the *Abergavenny* had taken from the stomach of a shark caught off the coast of Haiti. On the evidence in these papers the captain of the *Nancy* was convicted. These papers, known as the "shark's papers" were put on exhibition in the Institute of Jamaica where it is said they may still be seen.*

The only shark attack which has ever come under my personal observation occurred in the Philippines, where my battalion was resting up at a God-forsaken little coast town after an arduous campaign. One of the fish pounds had been torn loose at the bottom from the supporting poles, and a number of canoes clustered about it for repair work. The first native to go down, taking rattan withes in his teeth, dove in. Hardly had he disappeared when there was a swirl below and he popped to the surface followed by a huge shark which whirled and dashed away. Amid great noise and confusion the man was hauled into a canoe. His loincloth had been ripped from him and on his thigh were two ugly crescent-shaped lacerations from shark teeth.

My explanation of this incident is that while the shark lay at the opening in the pound, the diver plunged almost onto him and that the surprised shark whirled and seized the man. Having tasted blood, the shark might have been expected to finish the diver but, following him to the surface, he was frightened away

by the commotion in the canoes. Be that as it may, the bitten man gave up fishing and thenceforth took employment on a copra plantation where, in the tops of coconut palms, he probably felt safe from sharks.

We got a late start from Nassau on the morning of June 24th, because it was the birthday of the Prince of Wales. That made it almost impossible to get a Nassauvian to work or even to bring us supplies—holiday is holiday in Nassau. When we finally did get off we ran to West End Bay, on New Providence Island, but we had saved time by purchasing bait in Nassau.

A novel interest in this fishing in the Bahamas was that we could see through the clear water what was happening at the other end of the line, sometimes five or six fathoms away. In Nassau I had tried to get an electric light bulb on a waterproof cable to connect with the boat's circuit and to be put overboard. The Prince of Wales having prevented this, I contrived an apparatus with the water glass and an electric torch, and with it spent part of the night in observation. The light attracted fish and, though the apparatus was none too satisfactory, I did see some interesting things before a barracuda, leaping at the light, nearly caught my hand and forced me to abandon the contraption.

Fish tactics

At sunrise we went to bait fishing with hand lines, "horsing" the fish in so quickly that we got after the sharks early. Soon after I had taken the chair I was hung onto another Tiger and fought with him till he was within fifty feet of the boat. We saw that fellow several times and knew that he was easily a five hundred pounder but he was not making the fight he could have made. After his preliminary rush he yielded readily to my pumping and then alternately followed in unresisting, or brought the line "solid." When we got a close view this peculiar performance was explained. He was a "roller." He would lie alongside the leader and move along with it, then, in a swirl of water, he would turn across the wire and roll it several times around him. Lying broadside to my pull he could not be budged until my pumping unwound him. Again and again this was repeated. Four turns of the leader around his thick body would bring the line against his rough hide and he seemed to be

*Brooklyn Museum of Science Bulletin, Vol. III, No. 1.

trying to do just that. Finally he succeeded, and "Snap!"—he was gone with two dollars worth of hook, swivels and leader hanging from his ugly jaws.

This was the first time I ever actually watched the performance of this trick but I am satisfied that it has been played on me many times. Once before this I saw a shark suddenly cease pulling, run under the line and sandpaper it in twain with his denticled hide. Unquestionably, too, sharks do sometimes reach the line with their teeth but more often, I believe, they cut loose with the rough hide of their fins or bodies.

The best catch

We returned to the anchor, picked up the gong, Burt laid a new slick and Hugh floated out a fresh barracuda. "Who-a-a" went the reel, with that bass note which means a slow run, and then the fish turned and swam leisurely toward the boat. He did not seem to know that he was hooked or if he did know it he was not in the least perturbed. When we saw him with the hook in his mouth, and saw what a big fellow he was, I yelled for the gong to go over and with Kemp's "Over, Sir!" the shark woke up and gave us a grand run followed by an hour of forward, back, starboard, port, while Hugh pumped and sweated. When the double came up the fight was nowhere near over for, with another surge, out went three hundred yards of line to be pumped back only to go again.

When after several such runs he was brought to the surface a hundred feet away, the shark changed tactics and began surging in small circles, diving and looping underwater and twice he went over backwards, rolling as he looped, like an airplane in an Immelmann turn—all in plain sight and to the accompaniment of a shrieking reel. What a fight! But Hugh was master of it and finally the shark committed the tactical error of swimming too close to Burt's poised dart which flew out and struck into the gills. A rush to the end of the lanyard, now leaving a pink trail behind him, and the shark was hauled in for the *coup de*

grâce—vitality and power conquered by a tenth of its strength, now slumped in the chair.

This Great Blue was the finest shark of our expedition and he deserves record of his measurements in this, his obituary: length, 11 feet, 7 inches; girth, 6 feet, 2 inches; weight, 954 pounds.

What a grand four days we had had—three or four big sharks each day and licked by larger ones than we had caught! We had found the lair of the Tiger and we were determined to go back to fight it out with him as soon as we could.

I should like to acquaint readers of NATURAL HISTORY with the many other interesting experiences we had with sharks on that expedition in the Bahamas and on a subsequent one the following year; but space does not permit. Besides, I hope soon to tell the whole story in a book.

L'envoi

There comes an end to every fishing trip; but part of the fun is always planning for the next. Cruising northward last time through the Gulf Stream, the high "gaftopsail" of a Hammerhead followed in our wake and I found myself longing to have him on my line. One might think that six days in a little tossing boat, through four squalls, ought to have taken the edge off our keenness but they had not. Why should a man go to considerable expense, endure many discomforts, and do so much hard work for the sole purpose of matching his wits and strength against those of a fish, when he does not want the fish anyway?

I can explain this no more than Carl Akeley could have explained the fascination of the African jungle—no more than Admiral Byrd can explain the delights of an Antarctic "igloo."

Perhaps it is the primitive instinct some of us have inherited from caveman ancestors and which centuries of civilization have not eradicated but, thank God, love of the chase is still in me, so

WIND IN!

More Fun with Sharks



GOOD BAIT: BARRACUDA. *Catching bait in the Bahamas for shark fishing is not drudgery be-*

cause angling for barracudas is a sport in itself, well worth the coming for



YOU CAN'T STOP HIM, so settle back in the harness and squeeze down the drag, while the big rod bows and the line hums like a telegraph wire



BRACE YOUR FEET and hold fast when your back will stand no more pumping and your line will not bear the strain of it. Never fight a big fish when he wants to fight. Never let him rest when he does not want to fight

ONE WHO KNOWS SHARKS,
*E. M. Schuetz, Bahaman Manager,
National Fisheries Corporation. His
business is the handling of them
commercially; his fun, the catching
of thousands of them*



*PUMP HIM UP! Your back may ache, arms
may be numb, hands may burn; but you must
pump him up*



(Above) AN ARMED ENEMY who would give no quarter. When, with glaring eyes and snapping jaws, he is brought to surface, he excites no pity

Globe

(Below) TEN FEET OF CARCHARIAS TAURUS, landed after a three-hour battle





(Above) "AT THE MAST": a big Dusky, brought in after a three-hour fight. This *Carcharinus obscurus* is one of the stubbornest of sharks

(Below) THE ENGINE PURRS HOMEWARD but the angler, dreaming, still sees dark graceful forms slithering through crystal depths



The History of the Valley of Mexico

Explore with the archaeologist an ancient trail which leads to the origins of the famous Aztec culture and sheds new light on the evolution of Mexican art

By GEORGE C. VAILLANT

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[This article is a résumé of the results of the expeditions by the author for the American Museum of Natural History from 1928 to 1936.—The Editors.]

THAT formidable term archaeology might be defined as history which you can see. The casual traveller, observing the architecture, painting, and social customs of a foreign country tends to take the archaeological point of view, since the picture he forms is visual rather than mental. On the other hand the school or college student in learning about that same country, would use printed texts giving the dates of sovereigns, economic situations, and political actions and would thus create in himself an intellectual impression, based on ideas rather than images.

Written records scanty

Now the Valley of Mexico before the Spanish Conquest was inhabited by peoples who developed writing very late in their career. Moreover this written record was largely pictorial so that events could be expressed, but not ideas. Another factor which rendered this textual material even more meagre, was the systematic destruction of the greater part of the native archives, since the Spanish Conquerors believed these writings to be idolatrous and works of the devil. Thus the historian of Indian Mexico finds even the short span of time in which writing existed, very imperfectly covered; and, to form a consecutive picture of the evolu-

tion of human culture in Mexico, he must rely on the *visible* remains of Indian culture, the architectural remains, pottery fragments, stone and clay sculptures, frescos, and whatever else has survived the action of time and the destruction of war.

Since the reader would find it an excessive labor to look at thousands of photographs, plans, and specimens, which compose the existing history of the Valley of Mexico, the accompanying chart, drawn by William Baake, has been prepared as a digest of the various elements which reflect the history of man in Central Mexico. This article will briefly interpret these data from the conventional historical point of view.

THE COPILCO-ZACATENCO CULTURE

(Approximately 200 B.C.—400 A.D.)

The earliest people yet discovered in the Valley of Mexico are nameless. While relatively uncivilized in comparison to the Aztecs, yet judged from the broad viewpoint of Indian culture in North and South America, they are by no means primitive. They had several types of well made pottery, the decoration of which showed the beginnings of a sense of design but chiefly satisfied aesthetic yearning in lustrous surfaces and variations in form and outline. Stone and bone tools were competently made, and grinding-stones and mortars attested to dependence on a vegetable diet produced by agriculture. Huts must have been made of wattle and daub, but as yet no complete plan of one has been recovered. Religious beliefs are reflected by the common equipment of the

dead with clay vessels and other objects for use in the after life. Chiefly, however, religion coincides with art in the production of many clay figurines, usually female. These may have been used as votive objects or as household images of saints, such as are used in Christian worship today. From these little idols we see that weaving must have been known, since the figures commonly wear elaborately twined turbans. While the form of government and other aspects of social organization remain lost to us, one human activity, trade, may be discovered through the occasional occurrence in the excavations of jade ornaments and shells brought from the south and west of Mexico.

These earliest remains are called the Copilco-Zacatenco culture from the two principal sites where they were found. Speculation as to the identity and tribal affiliation of the makers is fruitless, when there is no mention of them in myth or legend. Yet from the styles and types of their artifacts we can readily distinguish whatever sites they occupied. It is difficult to determine when the makers of the Copilco-Zacatenco culture flourished, but the matter is worthy of some speculation.

Archaeological dating, in the absence of specific written testimony, depends on stratigraphy, the study of the sequence in the ground of layers of human culture. Especially favorable for such research are rubbish heaps, since the objects at the base of an undisturbed midden must be older than those at the top, which were obviously the most recently deposited. One bed of Copilco-Zacatenco refuse attained a depth of twenty-five feet. By carefully peeling the strata, it was possible to distinguish five successive styles of figurines evolving one from another. It must have taken several centuries for the ordinary household débris of a village to accumulate to such a depth, and the evidence of artistic development involving the slow gradual evolution of an unadvanced culture confirms this impression of a long lapse of time. A very rough comparison of this accumulation with another dump in New Mexico of known duration suggests the passage of some five or six centuries.

THE CUICUILCO-TICOMAN CULTURE (Approximately 400-700 A.D.)

The Copilco-Zacatenco culture, just described, ended abruptly. It was replaced by

another culture with new pottery styles and figurines, the makers of which were distinguished from their predecessors by a slightly different physical type. No tribal name individualizes these new-comers, so that the selection of a distinguishing term, Cuicuilco-Ticomán, was based on the type sites where this culture was discovered.

The craftsmanship of the Cuicuilco-Ticomán culture was superior to its predecessor. Sculpture, to judge from the little clay figurines, showed considerable anatomical fidelity and pottery decoration is characterized by a greater capacity in design. However, various culture traits imply an intellectual advance and the possibility that this culture contained the germs from which grew the great theocracies so characteristic of Mexico. For example, several idols of stone and clay represent a specific divinity, the Fire God, who plays an important part in later theological conceptions. Previously in Copilco-Zacatenco times, there had been no visible attempt to differentiate formally the various divinities. Ceremonial architecture, like the great oval mound at Cuicuilco, and other mound sites in Puebla and Morelos, attest to a centralized government, probably priestly, which could control and direct the tribal activities.

Whereas the preceding Copilco-Zacatenco culture seems relatively restricted to the immediate vicinity of the Valley of Mexico, Cuicuilco-Ticomán is more widely spread, extending into Morelos and Puebla and as far east as Vera Cruz. Local styles indicate that there were probably several separate tribal entities within the wider culture group.

Dating the cultures

The element of time is baffling and complex. In the Valley of Mexico we know from the evidence of stratification that the Cuicuilco-Ticomán culture supplanted the previous one. There is evidence in Morelos that the culture existed in a crude and early form contemporaneously with Copilco-Zacatenco. Presumably then the Cuicuilco-Ticomán complex after attaining a certain cultural level invaded the Valley from outside and driving out its previous occupants held it for themselves. Trade pieces from the succeeding Toltec civilization, which shows strong indications of having originated in a branch of Cuicuilco-

Ticomán, suggest a partial overlap. Therefore since the great Toltec site of Teotihuacán is supposed to have been founded around the beginning of the eighth century, we have a rough terminal date. Stratigraphy shows three time phases disclosed in rubbish beds a third to a half as deep as the Copilco-Zacatenco middens. Thus if we allow three centuries for the later culture and six for the earlier we arrive at the rough approximation of 400-700 AD for the duration of Cuicuilco-Ticomán and 200 BC to 400 AD for Copilco-Zacatenco. A confusing factor is the presence of a lava flow which surrounds the Cuicuilco Mound, and suggests great antiquity. However, as there is no good internal means for dating lava flows, it is safer to place this one as late on the basis of the material beneath it, than to make a wild shot in the dark at the age of the flow and ignore the archaeological evidence.

THE TOLTEC CIVILIZATION (700-1100 A.D.)

The next group to occupy the Mexican scene are the Toltecs, who bear the name given them by the wild tribes who supplanted them. There exist also traditional accounts distorted by myth that elucidate certain events of that time which ended in disasters produced by drought and the invasions of wild tribes. The clearest picture of Toltec civilization is given by the visual elements existing at the archaeological sites of Teotihuacán and Azcapotzalco, which tradition ascribes to the Toltecs.

Using the same criteria (pottery, stone, and architecture) that we used for our estimate of the rather drab cultures of Copilco-Zacatenco and Cuicuilco-Ticomán, we find evidence of a great material and intellectual advance. Pottery divides itself into well made vessels for domestic use and ornamental vessels for service in rituals, which carry complex designs involving theological symbolism. Sculpture progresses from simple beginnings in the Ticomán styles to sophisticated presentations of human beings and grotesque divinities. The mold was introduced at this time so that votive objects could be standardized and contribute thereby to a more rigid observance of ritual. Stone sculpture was developed to the point of carving decorative friezes in high relief as

well as massive figurines of heroic size to symbolize the gods. One of the frescos that has survived shows an elaborate ceremony where ornately garbed priests make burnt offerings to massive idols.

Social organization seems to show the same advance manifested in the material culture. A government, presumably priestly since the emphasis everywhere is on religious symbolism, was sufficiently well organized to induce the people to rear a sacred city, laid out not only according to plan but also according to elevation, to judge from the harmonious grouping of temples and platforms of various heights. The spacious disposition of rooms in the residential structures indicates that living conditions had improved, at least for the ruling class. Religion gradually became transformed from an unspecialized direct worship of two or three major divinities to a highly specialized ritual involving many grades of priests to serve a number of gods with carefully defined functions. In design, a rich symbolism suggests if not a system of writing at least the beginning of one, and there is even some evidence that the ritual calendar so characteristic of Central American civilization was in use. Finally the far flung sites where material of Toltec type is found, indicate a cultural dominion over a very wide territory.

Tradition as we have seen ascribes the fall of the Toltecs to a prolonged drought followed by the invasions of wild tribes sometime into the twelfth century. Certainly there is no evidence at Teotihuacán of anything so sudden as a siege followed by a raid of the sacred city. The wild tribes must have filtered in very gradually since there are tales of the newcomers marrying Toltec women and absorbing the local culture. Yet many Toltec towns must have survived after the collapse of the principal city. The archaeological evidence at Azcapotzalco discloses a late period not found at Teotihuacán, where there was a rich if decadent culture, suggesting that long twilight of the Roman Empire found in the Byzantine civilization.

THE CHICHIMEC PERIOD (1100-1350 A.D.)

Historical tradition which tells of the intrusion of the wild tribes to bring an end to the Toltec dominion, is sustained by the

archaeological evidence. Overlying many Toltec sites one finds pottery and figurines which by their heterogeneity in shape and design suggest the presence of various tribal groups. In fact in many cases there is a precise correlation between the tribes mentioned in the chronicles and the pottery types found in the regions occupied by these peoples. The traditional date for the dispersal of the Toltecs and the coming of the migrant peoples in the twelfth and thirteenth centuries is confirmed by trade pottery which also appears in sites of the same period in Yucatan.

Previous to the twelfth century the various groups seemed to participate in a succession of common cultures culminating in the Toltec civilization. After this time we enter a period where highly specialized local cultures suggest a complete lack of political unity, an impression borne out by the tribal traditions which describe an infinite succession of petty wars. In the early part of the fourteenth century various new groups are reported to have entered the Valley bringing with them a knowledge of writing and the worship of Tezcatlipoca, the chief god in the Mexican pantheon. Coincident with this sudden entrance of civilization, the political picture changes. By the middle of the fourteenth century two great city states, Azcapotzalco and Texcoco, succeeded in dominating their neighbors and mutually contested the hegemony of the Valley.

THE AZTEC PERIOD

(1350-1520 A.D.)

The situation became like that in modern Latin America, where people partaking of a common culture and speaking a common language strive for political dominance. The native histories, in which improved proficiency in writing enable the student more exactly to follow political events describe in great detail the struggle between the brute strength of Azcapotzalco and the cultured guile of Texcoco. By the end of the fifteenth century the former had emerged victorious.

At this point the Aztecs appear on the scene as a political power. For nearly a century they had been a poor and insignificant tribal group. In the first quarter of the fifteenth century they seem to have instigated a general revolt against Azcapotzalco, inducing not only lesser

towns like Tacuba but even the shattered power of Texcoco to take arms against the oppressor. They won a signal victory and with their allies extended their dominion year by year until shortly before the Spanish Conquest in 1519, they received tribute from all of southern Mexico as well as Guatemala and the Vera Cruz coast plain.

We have abundant information on the Aztec civilization from the first hand accounts of Spaniards, and Spanish-educated natives. The economic and social life of the people was focused on religion. All life centered in the nourishment and placation of a complex and numerous group of gods. The priests being spiritually in closer kinship to the divinities not only led in sacrifice and fasting but also instructed and controlled the civil population in the performance of their duties.

Religious calendar

Although infinite subdivisions of class and trade took place in the civil population as their culture grew more complex, the religious ritual expanded to control these new developments. The calendar or sacred almanac was an effective means for this domination of religion over civil life. Every day and every night was under the protection of one or another of the various gods and goddesses who had to be appeased. Special gods presided over the weeks and months. So completely were the people governed by the calendar that at the completion of their cycle of fifty-two years, a large unit of time corresponding to our century, they thought that the world might end if the gods were not sufficiently propitiated to renew life again.

Before the new year, all hearths were extinguished, all household utensils broken and discarded, the people gave themselves up to fasting and lament. The priests repaired to a high hill just outside of Mexico City and made sacrifices. When the gods signified their approval, at dawn of the New Cycle, a new fire was kindled in the heart of a sacrificed slave, and runners with torches lit from this blaze ran to light again the hearths of temples and houses in every part of the Valley. Great rejoicing arose, and the people redecorated their homes and temples, made new household furnishings, and were ready to enjoy the life secured then for another fifty-two years.

Many writers have called attention to the drama of the custom but it has a very strong archaeological significance as well. This wholesale destruction of property at the end of the old cycle must have left enormous accumulations in every village. In various excavations in the Valley we have found deposits of broken pottery that appear to be the result of mass breakage and not the gradual accumulation of material discarded in the course of everyday life. It seems perfectly logical to identify these dumps as the result of cyclical destruction. Moreover the practice of successively enlarging temples may result from the renovations undertaken at the birth of the new cycle.

It is feasible, therefore, to correlate archaeological styles with these cyclical destructions and renovations and thereby arrive at an absolute instead of a relative dating for Aztec culture periods. With the aid of stratigraphical data from ordinary middens, it was possible to isolate the dumps emanating from the New Fire ceremonies of 1507, the last ceremony before the Conquest in 1519, of 1455, and of 1403. The Mexican excavations at Tenayuca revealed five renovations of a temple, that might be correlated with the cyclical rites of 1507, 1455, 1403, 1351, and 1299. The internal evidence of types and styles seems to substantiate the hypothesis. Material from the dumps of 1455 and 1403 is rare in Tenochtitlan, the ancient Mexico City, whose importance was relatively insignificant during that period, but is especially common in the region controlled by Texcoco, the dominant center at that time. A change from non-Aztec to pure Aztec architectural style at Tenayuca corresponds to the renovations of 1351, when Aztec culture began to flourish during the era of the final unification of the Valley.

Progress

Thus we have evolved a finely graded instrument to compare the visual information gained by excavation with the textual history of the documents. Instead of an impression of a land torn by intensive strife as set forth in the chronicles, we see through archaeology a steady cultural advance. Houses become successively larger and more logical in plan. Temples grow in size and majesty. Sculpture becomes more skillful. The ceremonial carv-

ings and frescos reflect the increasing complexity of the theology, until we can visualize the abstruse developments mentioned by the historians. In the refuse heaps we find more kinds of things made in more varied ways. Dumps of towns under Texcocan domination produce finer objects than do those of the Mexico City Aztecs, exactly reflecting the historical position of the Texcocans as an older, more civilized and better established group than the Aztec who were militarists, only in later times able to enjoy the fruits of civilization. In one style of pottery it seems possible to see a dim reflection of the national state of mind, epistolary designs at the time of the introduction of writing, formal ornateness at the renascence of Texcocan dominion, coarse conventionalization during the period of political expansion, and finally the totally new conception of naturalism when the Valley tribes settled down to enjoy the fruits of Conquest. Especially significant are the abundant trade wares attesting to commerce and the tributes wrung from subject tribes. The conclusion one reaches is that human culture in the Valley of Mexico continued to progress during the fourteenth and the fifteenth centuries, in spite of bitter political struggles. Indeed were one to study the history of Europe and the United States with personalities and national situations erased, there would likewise appear an orderly and brilliant ascent to successively higher levels of civilization.

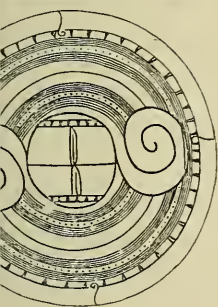
Archaeological research in Mexico stops with the Spanish Conquest. It is tempting to think of using the spade to evaluate the later phases of Mexican history, during the Colonial Period, the Republic, and the modern era of increased mechanization. Perhaps then we would be able more fully to formulate the nature of the data acquired by archaeological research. We can see the development of civilization and the fruits of human activity, but the actions of individuals and tribal groups are conspicuously absent. Yet the impression remains that, even if perfection demands the presence of the individual in the pages of Mexican Indian history, it would mean adding to the present record, not changing it. One is tempted to enunciate the heresy that human progress does not depend on political parties or economic creeds, but rather on the continuous effort of mankind to dominate nature and to develop a life worth the cost of living it.



No. 2 Notable, with
Fire ceremony of 14
1455. No. 4 Record



ca after the renovations



2

ical dumps of 1403, 1455.



e the 5th century. Nos.
g goddesses. Com-

The History of the Valley of Mexico

Archaeology must be seen, not read. The four panels represent the successive stages of Mexican art, during the Archaic, the Toltec, the Chichimec, and the Aztec phases. During the Archaic Period (approximately 100 B.C.-700 A.D.) writing was unknown and architecture little developed so that cultural studies must depend on pottery and figures. In the Toltec Period (approximately 700-1100 A.D.) formalized architecture begins; but not until the Chichimec Period (approximately 1100-1325 A.D.) are there historical records of value. The Aztec Period (1325-1520 A.D.) is fully documented and it is possible to compare the documentary with the archaeological evidence. It is through the study of the styles of architecture, pottery and sculpture that the archaeologist must base his historical conclusions on Central American archaeology.

Drawings by William Baake

PANEL I Archaic Cultures (about 100 B.C.-700 A.D.)



Section of a rubbish heap at Zacutenco, in which may be studied the succession of cultures. There were no written records at this time



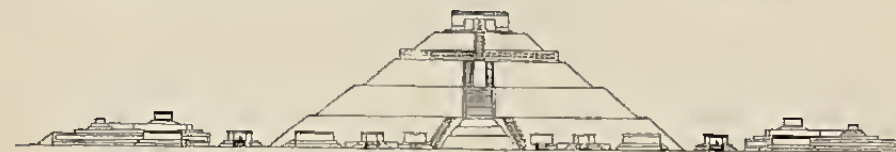
Section of the oval mound at Cuicuilco. The interior is of adobe and the exterior faced with stone

PANEL II Toltec Civilization (about 700-1100 A.D.)

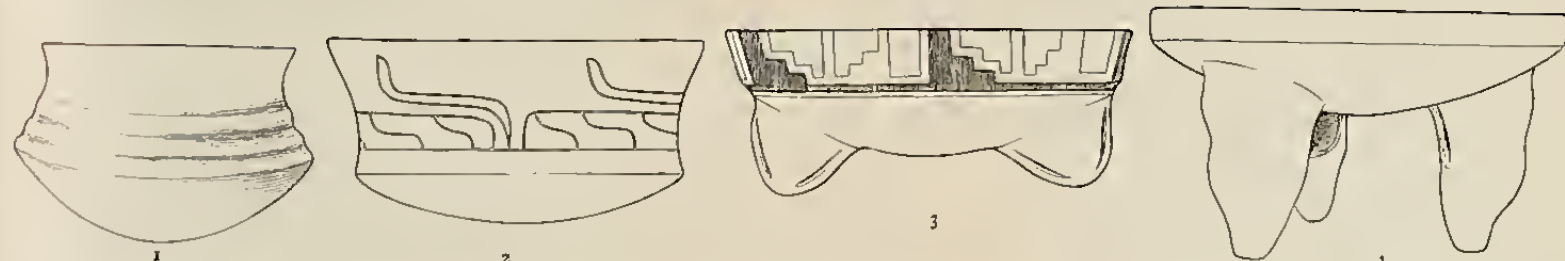


Fresco from Teotihuacan showing a Toltec ceremonial. Note the male and female figures making offerings to the idols, before which fires blaze on the altars

The Aztec Calendar stone in the center of which is represented the Sun God. The encircling bands describe the days of month and other calendar signs. This stone symbolizes the sacred nature of time and the heavens



The Pyramid of the Sun and surrounding temples at Teotihuacan. Note the majestic character of this religious monument

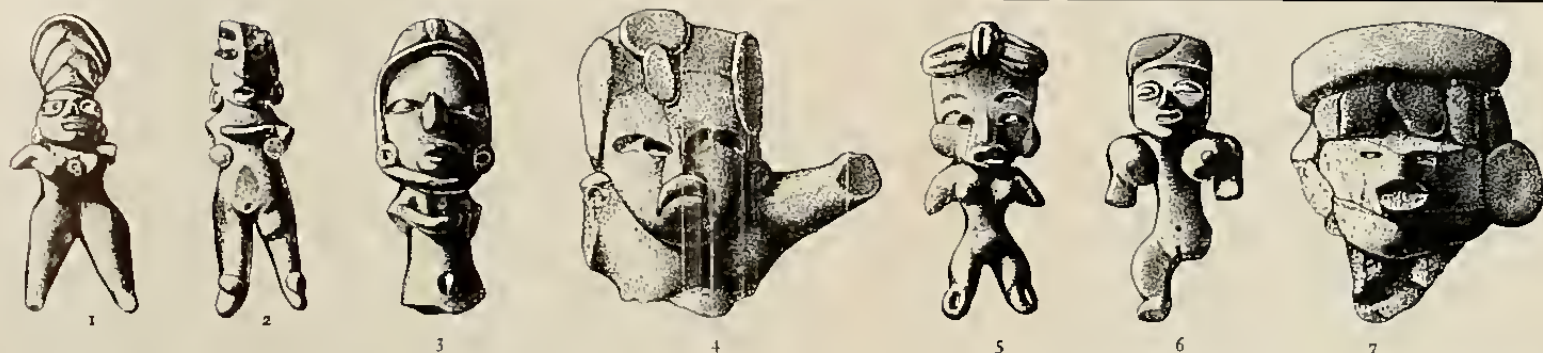


Nos. 1-2 are vessels of the Copileo-Zacutenco culture, the earliest yet discovered in the Valley

Nos. 3-4 are pots of the later Cuicuilco-Ticomán horizon. Note the use of tripods and painted design



Pottery vases, Toltec. Rich decoration and symbolism mark the first two vessels. The third shows degeneration in design at the close of this epoch



Nos. 1-4 represent successive stages in the evolution of the figurine at Zacutenco

Nos. 5-6 show earliest and latest types of the later Ticomán figurines. No. 7 An early Toltec figurine which may have evolved from No. 5



Stages of Toltec sculpture in clay. The first two figurines show affinity with the archaic technique in the first panel.

The third figure shows great skill in modeling and the last two mold-made pieces represent the plastic of the last phases of Toltec art



Scenes from pictura records. No. 1 shows a representative of a wild hunting tribe. No. 2 discloses the Aztecs setting forth on their wanderings which end finally in the Valley.



No. 3 shows some of the tribes each with its identifying symbol, which supplanted the Toltecs and founded city states in the Valley.



PANEL III
The Chichimec Period
(1100-1325 A.D.)



Scenes from picture records: No. 1 shows Quinatrin, ruler of Texcoco, receiving the tribes who brought the knowledge of writing in 1325. Each bears his identifying symbol.



No. 2 Notable, with year signs and symbols for the New Fire ceremony of 1403. No. 3 The New Fire ceremony of 1455. No. 4 Record of the New Fire ceremony of 1507.



Note the captured temple and designation of eclipse and earthquake. No. 5 The conquest of Mexico in 1519 as seen by an Aztec scribe.

PANEL IV
Aztec Period
(1325-1520 A.D.)



Reconstruction of the stages of the Temple at Tenayuca. No. 1 is the original building. No. 2 the building after the renovation of 1299. No. 3 the reconstruction of 1351.



where it takes the form of the regulation Aztec buildings in the next panel.



Successive stages of the temple of Tenayuca after the renovations of 1403, 1455, and 1507. Note the massive size after the final reconstruction.



Each tribe at this time made its own type of pottery. No. 1 Mazapan type perhaps made by the Acolhua.



No. 2 Coyotlatelco type perhaps made by the Tepanec. No. 3 Colhuacan (Aztec I) style of the Culhua.



Nos. 1-3 Aztec bowls from the cyclical dumps of 1403, 1455, and 1507. No. 4 naturalistic design from Aztec bowl made after 1507.



Figurines of the Chichimec Period were crude but variegated. Nos. 1-2 are Coyotlatelco, Nos. 3-4 are Mazapan in type.



Nos. 1-2 Mazapan figurines. Nos. 3-4 Aztec figurines of the fourteenth century. Nos. 5-8 Aztec figurines of the fifteenth century representing gods and goddesses. Compare the crude style of the clay figurines with the masterly execution of the Calendar stone, 13 feet in diameter.

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Rolling Down to Mexico

A journey in photographs, by Charles Coles, Staff Photographer of the American Museum, in which NATURAL HISTORY Magazine blazes the trail pictorially for motorists who covet the varied charms of a foreign country. Such a trip was not possible until the 763-mile road from Texas to Mexico City was thrown open to American tourists last July

WELCOME TO MEXICO: the inevitable customs inspection is thorough but courteous. Porters, subsisting only on the tips you proffer, handle your luggage. On the left, the Immigration Office and on the right the Customs



Photo by W. Henschel



NUEVO LAREDO, WHERE THE ROAD BEGINS: as you travel down this street the sharp contrast of the low Mexican buildings to the comparative skyscrapers of the American Laredo strikes the traveler immediately



Photo by W. Henschel

TOURIST CAMP, MEXICAN STYLE: these splendid accommodations are at Monterey, 148 miles south of Nuevo Laredo

WEIRD SILHOUETTE: *Yucca* trees stand against the desert sky, along a fine paved road continuing south of Nuevo Laredo. Voices span the desert in a twinkling through the wires seen over the tree

DEPARTURE AT DAYBREAK: this view through the palms at "Apartamentos Regina para Touristas" greets daybreak risers starting early on the next lap of the trip



A HALF HOUR FROM MONTEREY: the Ranch of the Beautiful View repays a side trip over this road to the mountains



Photo by W. Henschel

"THE BEAUTIFUL VIEW" refers to the splendid Horse-tail Falls which pours down the mountainside into a valley of tropical luxuriance. This falls was characterized in one guide book as "over-rated"



HOTEL AT VICTORIA: the second night may be spent in this hostelry. The cars are parked in the patio around which the rooms are grouped





RELIC OF SPAIN'S CONQUEST: *as you leave Victoria, you will see this church which is claimed to be over 400 years old*

REFUEL BY FUNNEL: *stopping for gas at Valles, you will be surprised at the variety of odd-shaped funnels used to pour gas into your tank from a ten litre measure. Gas pumps are not trusted*

CROSSING THE TROPIC OF CANCER: *thirteen miles south of Victoria, you pass into the tropical zone. Close to this point you rise to the top of the Mesa de Llera for a sweeping panorama*



A DELAY: just beyond Valles travelers formerly had to take a "siesta" while waiting for a ferry. The hot tropical sun can be mighty uncomfortable without the shelter of palm leaves



POWERLESS CONVEYANCE: *this primitive ferry was propelled across the river by the action of the current against the sides of the raft. A steel bridge now spans the river*

ANIMAL LIFE ABOUNDS *in the palm forests stretching to the horizon from each side of the road. The motorist gets some idea of the dense jungle through which the road was built*



"THOMAS AN' CHARLIE" (common name for Tamazunchale) will probably be your next night's stop. If you stay at the Hotel Vega you will have this view from your room. The small building is in the patio of the hotel and is the home of the owner, Señor Vega



GRACEFUL WOMEN of the Huastecan Indians, as seen from the Cafe Royal in Tamazunchale. The natives had never seen an automobile before the building of this road



CLIMBING MOUNTAINWARD: as you leave Tamazunchale at an altitude of 500 feet, the road rises steadily, following the Rio Montezuma

ABOVE THE TROPICS: *fields, planted by Indians suspended by ropes from trees make a patch-work of yellow and green on the steep slopes. The road has now climbed to an altitude at which temperate zone plants will grow*



CUT THROUGH SHEER ROCK: *here the road is at an altitude of 7500 feet, where occasional landslides make maintenance difficult*



BLANKETS OF CLOUDS *are formed on the cool heights by the warm moist air which rises from the tropical lowlands. Magnificent views charm the motorist at every turn in the highway*





JACALA, END OF THE MOUNTAIN ROAD: *when this little town appears, you will know that it is only 163 miles to Mexico City, over a fast, paved highway*



THE HIGHEST POINT OF THE ROAD (9000 feet), although beyond Jacala, is passed over so easily that it is hardly noticed. The country again takes on the character of semi-aridity where cacti flourish. You are now in the Valley of Mexico



FOR THE FIRST TIME IN HISTORY the motorist can step out of his car in a foreign metropolis. Mexico City, once the Aztec capital, is a modern city, yet at every turn are reminders of its ancient past

Bird Courtship

Do the male's fine feathers attract the mate he wishes to win? Observations which question the adequacy of Darwin's theory of sexual selection

By H. N. SOUTHERN

PERHAPS no other aspect of Darwin's work has been criticized so much as his theory of sexual selection. Chiefly it points to the advantage of bright plumage in male birds in the mating contest, and offers an explanation why in so many species the male is brilliantly adorned while the female is dull. The individuals that are most brightly colored have the greatest success in securing mates, according to the theory of sexual selection, with the result that the brilliant features are transmitted to the offspring in greater and greater degree.

Fine feathers

While this theory has been applied principally to birds, some fishes and arthropods and even a few of the higher vertebrates have characters which point in the same direction. On the face of it the theory sounds quite reasonable and explains a number of things in the bird world which are mysterious upon any other hypothesis. The elaborate visual display of the peacock and equally the complicated antics of dull-plumaged birds like the Old World warblers seem to answer to no positive purpose that would improve their chance of survival, unless to that of appealing to the discrimination of the hen bird. Far from being of value in the struggle for existence, the peacock's tail must be a positive burden to him, and if there were no counter-acting factor, birds with such a senseless over-development of one of their organs would be speedily weeded out.

If it is accepted that the elaboration of color, form, and movement is critically ap-

preciated by the females, and that they choose those mates which by a greater riot of color or a greater abandon of posture can stimulate them to successful mating more readily, then it will be clear that the hereditary factors for these characters will be handed on to the offspring more frequently than others.

While there is no doubt that sexual selection can actually be discerned in operation in certain cases (the observations by Edmund Selous upon the courtship of the ruff are convincing enough for all but the most captious critics), there are a number of difficulties that arise. Many instances are recorded of cock birds with poor plumage getting mates while more brightly colored competitors are condemned to bachelorhood. The hen in many cases seems to be quite oblivious of the display that is going on and seems pointedly to look the other way. This is curious if the stimulation is by a visual image. Again it would seem to be equally important for the future of the race that the hens should also undergo a form of selection since they contribute half of the hereditary factors of the next generation. Eliot Howard has shown that in the warblers at least the possession of a territory is a more important factor in securing a mate than an elaborate display.

Chance observations

As with most zoological controversies the correct answer seems to be a compromise, an acceptance of the fact that sexual selection has been seen to occur with the proviso that many other factors may be equally if not more important. There is much still to be learned about courtship and display before we can dogmatize, and this material can only be col-

lected by painstaking and co-operative observation. If only there were a way of collating the various facts that are known, we should have progressed some way: so many people who are out hunting for something entirely different, drop across some incident of importance, though they do not know it, and the information remains locked in their heads or reported in parenthesis in some quite unsuspected journal. If we could only organize it, there must be quite a large body of facts to draw upon.

As a member of an ornithological expedition to the Shetland Islands in the summer of 1935, I was able quite accidentally to record several observations of interest upon bird courtship, though the purpose of the expedition had not been connected with this at all. It only shows how anybody may come across information in the most unexpected way, which should be made known.

Birds on the Shetlands

The Shetlands are a barren group of islands lying at the extreme north of the British Isles about 55 miles northeast of the Orkney Islands, and the capital town of Lerwick is situated almost exactly upon latitude 60° N. The coast line is everywhere rocky and precipitous and supports a tremendous population of sea birds. Two species of skua are fairly common there, the great skua, or bonxie, as the Shetlanders call it, and the smaller Arctic skua (better known in America as the parasitic jaeger), which both live in a piratical manner by chasing the various sea birds and compelling them to divulge the cargoes of fish that they are carrying back to the nesting ledges.

In making a survey of one small island on the east side of the mainland we noticed that the bonxies tended to collect upon one particular ridge about half way up the moorland slope that formed the main part of the island (there are no trees in Shetland, and so the bird population is entirely ground or cliff nesting). Having a day or so to spare we decided to spend some time watching what was going on at this "club," and after a few hours we found that events were so interesting that we put up a "hide" and managed to take some photographs of the proceedings. It was one of the most pleasant places we had ever been in to make bird observations, and one's attention was continually being distracted, if one was

not careful, to the splendor of the surrounding scenery. The island rose steeply in its short breadth of a mile and a half to 600 feet, so that even from this ridge most of the south-east part of Shetland stretched out before us penetrated by sinuous fingers of blue water. In fact so broken up is the coast line, that no part of the islands is more than three miles from the sea.

Courtship of the bonxie

The books informed us that the courtship of the bonxie consisted of mutual wing-raising by both sexes, displaying the white webs of the proximal part of the primaries and flashing them into view as a sort of surprise, as do so many birds with hidden patches of color in their plumage. What puzzled us was that this could be seen going on all over the nesting colony, and did not appear to have any special courtship significance. It was used for greeting, for remonstrance when one bird intruded into the territory of another, and as a general expression of excitement or self-assertion. Observations on the ordinary nesting territory did not seem to give us much information as to the real courtship, for surely this was only a poor pretense at it. Apart from that, of course, the hillside was exciting enough on account of the bonxie's habit of stooping at intruders. It takes a certain amount of self-control not to duck automatically when these great brown birds with a wing spread of five feet or so come hurtling straight at one, but almost without exception they check upwards when they are about two or three feet away from the object of attack. They look so terrifying with their big heavy bodies, and when seen soaring in the sky are curiously reminiscent of eagles with their great wide sails of wings.

But to return to the ridge: we found that after we had settled ourselves down in the heather at a point of vantage, birds would begin to return in ten minutes or so, all making for this one particular spot out of the whole island. One small patch of it was worn absolutely bare of herbage by the feet of countless generations of bonxies. Each new arrival would be greeted with upraised wings and a hoarse call by at least one of those already present and sometimes the emotion would communicate itself to a number of them.

Several of them were sitting in obvious

pairs, and of these one especially was very active, the female brooding on an imaginary nest with great solicitude, while the male stood by her and raised his wings at the slightest provocation. Soon she stood up and the two birds stood breast to breast calling and wing-raising. This happened several times and fizzled out, but finally the male started to adopt entirely different tactics: he puffed out his neck feathers until they looked twice the normal thickness, and strutted with head in the air in front of the female. Up and down he went in a kind of sentry-go, until the hen who was standing up and calling reciprocally at first finally sat down and mating was accomplished. On several occasions we saw this procedure end with the refusal of the female to take part and the male was driven off. On every occasion that we watched, these activities were constant, though it should be remarked that a number of the birds present at the gathering (sometimes between twenty and thirty were seen out of a total breeding population for the island of 60 pairs) seemed to be males whose mates already had eggs on the nesting ground nearby.

The interesting thing is to find that the courtship of the bonxie is not after all a mutual affair, as one would guess from a superficial knowledge of their activities (i.e. the wing-raising) and from their close relationship with the gulls, but one in which the male has a definite display of his own. The question as to whether the birds who can strut the best are sexually selected is, one feels, rather doubtful, and the whole complex behavior of the bonxie at this time of year needs more thorough investigation. The noticeable social atmosphere in a bird which is bold enough not to need the safeguard of flocking, is one of those elaborate conventional patterns of behaviors that one finds among birds that exhibit more than the usual care of the young, and may form a sort of bond of a psychological nature to keep the parents, as it were, "interested in their job."

Love-making of other birds

The probable significance of the wing-raising and calling with open beak as a primitive feature of the bonxie's courtship was made more probable to us by observing the love-making of several of the other sea birds that nest in Shetland. Certainly one of the most

interesting of these is the fulmar petrel, twos and threes of which were always to be seen performing their antics on any raised surfaces which gave them opportunity to land. The accompanying photographs were taken at the peat stack just outside the house which served as our headquarters. Admittedly there is a great deal that is mysterious about the fulmar's behavior, but the main principle is obvious enough. Two birds sit close together, straining their beaks forward and calling with a guttural "kuk-kuk-kuk-kuk-kurrrrrr," at the climax of which the head is twisted and waved about so that the mauve-colored interior is suddenly displayed. Here is a clear case where stimulation is completely mutual, and presumably the birds that can produce the best reaction upon each other will be the most successful breeders. If we are true Darwinists, we shall make an extension and call this "intersexual selection," and argue that the bright colors of the inside of the mouth in many seabirds have been produced in this way.

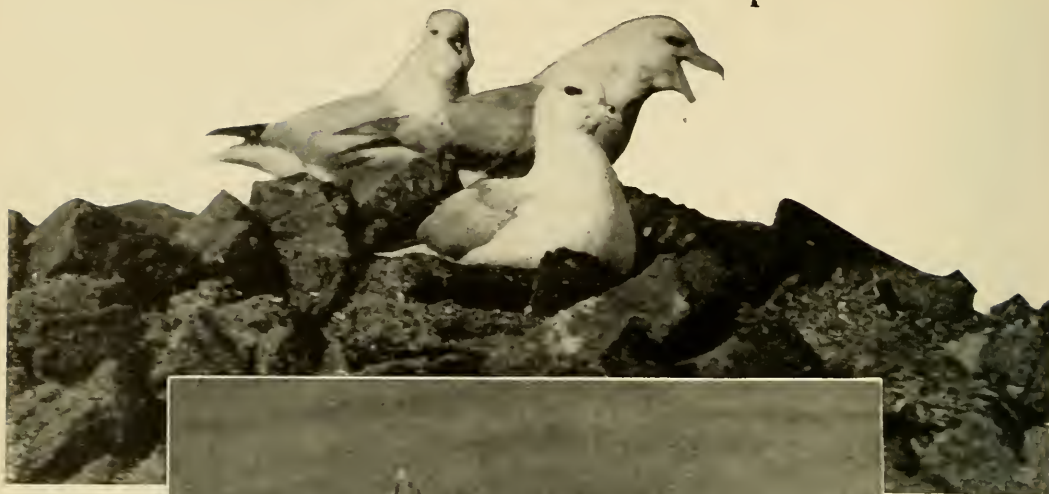
Not the usual triangle

Again, however, the case is not half so simple, and our interpretation of the fulmars' behavior was constantly being complicated by the arrival of a third bird who would join the party and perform just the same actions. If it was a case of simple one-sided selection, we might be tempted to think that two males were contesting for the female, but in cases even where one of the three birds was incubating, these three-cornered performances would be observed going on, and the whole thing seemed to take on more of a social significance. In addition there is the fact that this kind of business is seen quite late in the summer, and we have a state of affairs closely resembling the "piping parties" of the oystercatcher, which occur when breeding is finished.*

Thus it may be concluded that, though sexual selection may be valid to a certain extent, it does not go deep enough into the problem of bird behavior by a long way, and it is quite impossible to explain complicated emotional situations by such a simplified and single explanation.

*Attention is called to a series of photographs illustrating the "dance" of the Laysan albatross published with an article by Homer R. Dill in the April, 1913, issue of NATURAL HISTORY.

Bird Courtship



(Top) A stern and rock-bound tryst: fulmar petrels engaged in vocal courtship

(Center) Promenade of a gallant: puffing out his neck feathers, the male bonxie struts importantly in front of the female, a phenomenon supporting the Darwin doctrine

(Below) Greetings, my feathered friend! Wing-raising is a social salutation as well as a courting gesture, among the bonxies



★ THE INDOOR EXPLORER

By D. R. BARTON

CRICKET ON THE MICROPHONE: Visitors walking among the insect exhibits on the third floor of the American Museum, will have their curiosity aroused by peculiar trilling sounds which apparently emerge from a darkened corner of the hall.



If these visitors happen to have what the psychologist calls "good associative dispositions" they will probably be reminded of summer evenings when they lolled comfortably in screened porches, lazily conscious of the incessant chirping crickets in the yard outside. That is exactly what they are listening to.

They will follow the sound until they reach an illuminated glass case housing several chubby crickets.

Now, these insects are not being given sanctuary from the winter frosts without a purpose. Inside their glass home is a microphone which is connected to a large amplifier or loud-speaker outside and above the "show case." This apparatus, which was devised by Mr. L. W. Holden, projectionist of the Museum's education department, makes the chirping of the crickets clearly audible to the visitor. Why? Not simply to stimulate pleasant summery recollections to tide him over the bleak winter. The real purpose is to acquaint him with the cricket at close range, and to show him how the cricket actually makes his chirp.

Fox Movietone News recently made a sound film of the cricket, thus presenting him for the first time on the screen. The Museum considers it a privilege to sponsor, what may be called his first "radio" broadcast, as well as his debut on the legitimate stage.

How he chirps

Only adult male crickets can chirp. The female of the species, easily recognized by the slim, needle-like "tail" with which she pierces the ground when laying her eggs, is one of the most reticent of her sex in all nature, and she rears her children in the best traditions: they are seen but never heard.

The reason for all this is quite simple. Immature crickets cannot chirp because they have no wings, and adult females cannot chirp, because, although they have them, their wings are not equipped with the male's chirp-making "musical file." Yes, the male cricket chirps with his wings.

Near the front of each front wing of a male cricket, is an enlarged rib or brace. On the under side of this rib is a series of small teeth. Then on the upper side of each front wing is a small rough spot so placed that when the wings are rubbed together, the teeth on the underside of one wing scrape on the rough spot that is on the upper side of the other. This rubbing of a file-like structure on a rough spot starts both wings to vibrating very rapidly, probably at a rate of not far from 5,000 shakes per second. This rapid vibration of the wings up and down as the male cricket rubs them against each other from side to side sets the air to vibrating in waves of such a character and frequency that our ears recognize a shrill sound or chirp.



From a microscopic study of the delicate lines on a "sound-film" recording of cricket's chirps, the Museum's department of insects has found, among other things, that (1) The cricket chirps, so far as its fundamental notes

are concerned, in the octave just beyond piano range. (2) Such a performance would, in musical terms, be called a beautifully executed "slur" such as would be possible for an expert violinist, except that the cricket does it in less than 0.03 second, and then in less than 0.02 second repeats it almost exactly.

Probably the first definite sounds made by land animals on this earth were made by insects. Before ever birds sang or even frogs croaked, insects had developed a chitinous covering, the segments of which, rubbing together, produced sound-waves. Whether these sound-waves were audible in the sense that there were organisms with nervous mechanisms attuned to them might be the subject of an interesting speculation.



ARTIFICIAL DEFORMATION OF SKULLS: Today, the prevalent and extensive use of cosmetics has come in for a good deal of criticism by our elders. Die-hard conservatives have wagged many a reproachful finger at the modern woman's "war-paint," although its defenders regard it as a phase of "the more abundant life."

Whatever your stand on the issue, you will be interested to know that this modern instance of cosmesis, (the art of improving and preserving natural beauty), is mild in the extreme when compared with primitive practices in general and the deformation of the head in particular.

The custom of deforming the cranium is shared by many peoples distributed over a world-wide geographical area. It flourished in Peru, among the Indians of Southwestern United States, in several Pacific islands and in certain localities in Asia. It is usually a conscious attempt to emphasize an ethnic conception of beauty by directing and inhibiting

the growth. The figure above shows the result of a distortion, carefully nurtured from infancy, on the head of a North American Indian. It should be remembered that the heads of male children were treated in this fashion quite as much as those of the females.

Dr. Harry L. Shapiro, Associate Curator of Physical Anthropology at the American Museum, observes that, "The crania which are classed as artificially deformed range from those so slightly affected as to escape notice to forms which are startlingly fantastic. The methods of deformation vary similarly from simple cradle board and bandages to elaborate machines which have all the diabolical appearance of medieval instruments of torture. The facial parts of the cranium are relatively less influenced by deformation than the cranial vault. Also it does not appear that deformation has any generally noticed effect on intelligence or the capacity of the cranium."

Dr. Shapiro has devoted much time to the problem presented to the anthropologist by deformed skulls recovered in excavations.

Due to the artificial formations the skulls are very difficult to classify, and lead to erroneous conclusions. To surmount this stumbling block, Dr. Shapiro has developed a formula which enables the anthropologist to calculate the exact proportions that would normally have characterized the skull, if it had not been subjected to the beautifying treatment.

There are several instances among Europeans where cosmetic customs have deformed the skull quite by accident. The celebrated paintings of the Dutch masters often portray the voluminous coifs and head dresses in vogue at their particular period. Investigations have disclosed frequent cases of cranial distortion clearly the result of the tightly bound fastenings of these contraptions which were worn from early childhood. We may conclude then, that the woman of today is not nearly as thorough a spartan as her ancestors or her primitive sisters in the matter of personal vanity, and that the masculine element of our present civilization is even less amenable to the ancient ordeal of adornment.

Your New Books

A Jungle Laboratory—New Guinea Art—African Safari—A World of Errors

SKYWAYS TO A JUNGLE LABORATORY—AN AFRICAN ADVENTURE

----- by Grace Crile

W. W. Norton and Co., Inc. Illustrated, \$2.75

BOOKS come and books go about Africa and we say when a new one turns up—just another book on Africa.

Many feel (including publishers) that Africa had all been done so there is nothing more to be said.

How far this is from the truth! Africa, more than any other country—for it is still very largely a vast undeveloped land—will remain full of unbounded material for years and years to come.

Africa is forever unfolding new phases of old subjects. And an entirely new Africa is being unfolded to us now that we have the airplane winging its way over this fantastic land showing us things we never saw before and spreading before us still newer wonders.

Grace Crile ably describes all this as she takes us the "new" way over Europe and up the Nile to the very heart of the "Dark Continent." Delightfully and easily written she tells of the thrills, the joys and hard work of a truly great expedition and the part she played in it. As wife of the famous surgeon, Dr. George Crile, head of the Cleveland Clinic Foundation-Cleveland Museum of Natural History Expedition, she accompanied him on this research expedition into the very heart of Africa where she kept the records of the trip day by day and also materially helped in and recorded the results of his scientific findings.

As a keen observer she sees and records also many interesting observations on the codes and customs of the tribes they frequently contact.

She describes vividly the building of their jungle laboratories; how they themselves lived, what they ate and what they all did.

It was a busy camp every minute of the day and often well into the night, as much very important work was to be accomplished.

Her impressions of the country and some of its weird and fantastic scenery is particularly descriptive. Her sensitive nature has endowed her with a gift to see and feel the beauties of this colorful land. And her gift to impart her observations to others has enabled her to produce a worth-while book.

Dr. Crile as the "Chief" heads his fourth expedition into the heart of Africa. Here is a great and prolific biological laboratory where he collects various species of interesting big game not as the many hunters who have gone before him, killing for trophies but for the sole purpose of scientific research that through these findings he may further help mankind.

All this is told in a fascinating manner—the flight over Europe, and the Mediterranean; over Egypt and up the Nile to Lake Victoria and then gliding down to Nairobi. The building of a field laboratory, then the thrills and dangers of getting the desired specimens, and the careful and critical work which followed the preserving, recording and studying of the glands of many strange animals.

Here is a fascinating story of how science ever strives to help us more and how the conservation of big game can serve mankind through science.

JAMES L. CLARK.

ART AND LIFE IN NEW GUINEA

----- by Raymond Firth

The Studio Publications, Inc., 381 Fourth Av. \$3.50.

THE reader who enjoys visiting art galleries and anthropological collections in museums should find this volume on the native art of New Guinea interesting and useful. There are many fine plates and just enough text to orient laymen and artists in the ways of the New Guinea native. The author is a distinguished anthropologist so his comments can be taken as authoritative. There is a brief discussion of the primitive artist in general in

which it is shown that primitive man is primarily a craftsman, interested in making useful objects; his art is merely the aesthetic treatment of such objects, the inspirations for which are drawn from his tribal culture. Finally, the relation between art as illustrated in the book and native village life in New Guinea is properly evaluated. In general, the volume might well serve as a high class guide to museum collections from the same area.

CLARK WISSLER.

ADVENTURES IN ERROR

----- by Vilhjalmur Stefansson

New York

Robert M. McBride and Company

THIS is a series of essays having to do with the old antithesis of truth and happiness. It is generally agreed that the person who insistently questions the accuracy of every popular belief is a social nuisance, so the author is to be commended for his optimism in issuing a volume to prove that most of what the reader has learned about the world is wrong and even silly. For one thing such behavior threatens one's sense of security. However, the reader should not take the book too seriously because most of the time he will be debating whether the author is a humorist or a reformer. The chances seem to favor the former. The chapter on the history of the bath tub is a case in point; everyone should get a laugh out of that.

The author begins by stressing his disapproval of all the debunking efforts leveled at Santa Claus, Washington, Lincoln, etc., but later on he sharply rebukes the living great who have made mis-statements about the arctic; for example Sir James Jeans and Robert Millikan, two great scientists, are shown to have talked nonsense about icebergs and in consequence the author wonders how accurate these great men may be in their own chosen field. There is a long chapter to prove that all the romantic stories about wolves are untrue, that wolves never run in packs and never hurt human beings, except by accident. In this case the reader may not be sure whether he himself or the wolf is debunked.

For the most part the errors discovered by the author have to do with the arctic. He makes the reader feel it a crime to mention a snowhouse because a lot of Eskimos never saw one; to believe that it is terribly cold in their country because there are places in the world where it is sometimes colder; to say there are no trees in the arctic, etc. However, the author's main point seems to be that we live in an unreal world, a world we have built up out of errors and in which we find our greatest happiness.

He thinks that those we regard as distinguished contribute most to the building up of this unreal world and is charitable enough to suggest that he, also, may have had a share in the construction.

He debunks arctic exploration, but believes there will be arctic explorers forever, because people like the romance of the unreal, especially when staged in the arctic of make-believe.

CLARK WISSLER.

YANKEE IN AFRICA

----- I. H. and Julie B. Morse

Published by The Stratford Company, Boston.

Price, \$1.50

Illustrated with snapshots by the authors.

YANKEE IN AFRICA, is a breezy, jubilant book delightfully written, swinging along in easy style recounting in a direct and simple way the reactions, thrills, joys, and at times surprises and even bitter disappointments of a lady on her first and her husband on his second shooting safari to the uplands of the East African game fields.

Mr. and Mrs. Morse, write rather along a personal vein but quite honestly so, for it is frankly as they saw and felt the wonders as they unfolded to them. It is quite the honest reaction of anyone going there and is for this reason refreshing for in reading it one feels himself taking the very trip so buoyantly described.

We follow the Morses over the rolling grassland plains, through patches of thorn bush, into the depths of jungles, seeing quite vividly the many strange animals and brilliantly colored birds of all sizes and hues. We encounter with them the ponderous rhino, the lion, and sometimes a snake, but always with more wonderment than fear. Natives, too, held their fascination and they tell of them as they found them, simple, child-like people but picturesque and colorful in their beads and feathers and magnificent in their deep copper skins and fine physiques.

Their trip was not without a purpose, for not only did they enjoy the Africa which they so ably describe but the specimens they collected were all saved to swell the already representative collection for their private museum which stands at Warren, New Hampshire.

They tell also how this museum, now known as the Morse Museum, was originally started by Mr. Morse as a private trophy room, but his collection became so large and so interesting that they most generously decided to open it to the public that others might enjoy with them these most unique and valuable souvenirs of their wanderings.

Privately maintained and entirely supported by the Morses, the Museum carries on giving joy to many others who are just as interested but not as fortunate and who must be the stay-at-home travelers. The Morses show a fine spirit in that they travel and enjoy the world but not selfishly so, for they in turn are giving it out to others.

We should have more of this kind of people and their kind of books.

JAMES L. CLARK.

PROBOSCIDEA

----- by Henry Fairfield Osborn

----- Edited by Mabel Rice Percy

A Monograph of the Discovery, Evolution, Migration and Extinction of the Mastodonts and Elephants of the World.

Volume I. Moeritherioidea; Deinotherioidea; Mastodontoidea.

The American Museum Press, New York, 1936

THIS sumptuous volume, together with the second one yet to appear, constitutes the final magnum opus of the foremost paleontologist of his time. It represents the fruits of a line of research begun in 1907 and continued through 1935, when its illustrious author rested from his labors. The volume before us has been on the American Museum Press since 1924, during which time the field of research has been greatly broadened and many discoveries have been made which alter the classification of the Proboscidea; the consequent alterations appear in the phylogenetic appendix.

At the time of the author's lamented death on November 6, 1935, the final revision of the manuscript was in progress. This has been carried out along the lines laid down by him; since that time no changes have been made in his determinations and necessary corrections have been inserted as footnotes.

Perhaps the most outstanding feature of this volume, which was also manifest in the author's work on the Titanotheres, is the emphasis placed on the phylogenetic classification in which, instead of the classic Linnean system based solely on zoologic observation and the creational concept, a phylogenetic system is followed in which all divisions from the subspecies to the order are placed vertically, as succeeding each other during geologic time, rather than horizontally as observed in recent or existing time by Linnaeus and all zoologists. This results in an amazing number of divergent lines of ascent, there being no fewer than 43 newly discovered multiple lines for the Proboscidea as a whole.

There were four primary stocks of Proboscidea established by the initial choice of food in different habitats:

(1) An amphibious stock, adapted to rivers and swamps, of limited powers of migration. Represented only by the imperfectly known *Moeritherium* of northern Africa and possibly (Pilgrim) of southern Asia in Oligocene time. MOERITHERIOIDEA.

(2) A southern forest stock, adapted to forested lowlands. Represented by the *Deinotherium* of northern and central Africa and of southern Eurasia; known from abundant remains in Miocene to Middle Pliocene time. DEINOTHERIOIDEA.

(3) A northern stock, adapted to lowlands, to savannas, and to forests, with better developed limbs and powers of wide migration. Represented from the Lower Oligocene of northern Africa to

the Miocene-Upper Pleistocene of Eurasia and North and South America. MASTODONTOIDEA.

(4) A Stegodont-elephant stock, adapted to plains, savannas and steppes; of browsing (forest) or grazing (plains) habits, also with powers of wide migration. Represented from the Lower Pliocene of southern Asia to the Pleistocene of North America and the Pleistocene and Recent of southern Asia and of Africa. ELEPHANTOIDEA. This last group constitutes the material for the second volume.

The position of the Moeritherioidea has been a matter of debate. Now, *Moeritherium* is excluded entirely from the ancestry of all later Proboscidea although a member of the order. It was an animal of amphibious habits comparable to the Hippopotami.

The Deinotherioidea are also an aberrant side line but had a decidedly elephantine body often of huge size and with a fully developed trunk, but no upper tusks. The sharply deflected lower jaw bore a pair of pointed decurved tusks, while the grinding teeth were very simple and unprogressive in structure. The use of these lower tusks gave rise to some remarkable and grotesque theories.

The greater portion of the volume treats of the Mastodontoidea. Originally, all that were known of this group were included under the classic genus *Mastodon* which because of subsequent discovery has been separated into 4 families, 15 sub-families, and 31 genera representing some 30 phyletic lines of ascent. The classification is by means of progressive divergent adaptations in the grinding teeth and tusks. The family classification is based on the fundamental pattern of the grinding teeth; the sub-family classification on the elongation or abbreviation of the mandible and the divergent adaptations of the inferior tusks.

The true mastodons to which alone the classic generic name is now applied include the *Mastodon americanus* so abundant in the forested area of the eastern United States. It was a short-jawed form with vestigial lower tusks.

The long-jawed mastodons are in many ways the most interesting of all and include several phyletic lines. Some had an extremely long mandibular symphysis and lower tusks which might be greatly elongated and narrowed, but never broadened. These are called the prod-tuskers. The shovelers, on the other hand, usually had broadened lower tusks, sometimes excessively broad, with a worn, chisel-shaped edge giving evidence of their use, and with reduced upper tusks. Of these, under the Bunomastodontidae, are the shovel-tusked Amebelodonts, the tuskless spoonbills, Megabelodonts, and of the family Serridentidae the extreme Platybelodonts. These animals are supposed to have lived on the roots and stems of certain aquatic plants such as the water lilies, as do the moose and muskrat of today.

Under each generic phylum there is a full historical discussion with original descriptions and abundant illustration together with some presentation of Osborn's convictions, but with no real revision of species.

The restorations are particularly interesting, all

of which were drawn by Miss Margret Flinsch, under the author's direction.

Altogether, this is a rarely impressive volume and represents a vast amount of research such as would be possible only to one in Professor Osborn's position. The final conclusions as set forth in the Appendix seem logical in the light of the carefully presented evidence, but whether other workers in this field will accept so extreme a phylogenetic classification as that herein presented remains to be seen.

RICHARD S. LULL.

FERNS OF NORTHEASTERN UNITED STATES

----- by Farida A. Wiley

(Of the American Museum of Natural History)

(Published by the author. Price \$1.00, plus fifteen cents postage)

IN this busy world, with all its strife and trouble, people are taking more and more to the out-of-doors for rest and recreation, to get away from the work and worry of their professions and occupations and to bring into life new experiences and new things to think about. Some take up outdoor games, while others go to nature for a study of trees, wild flowers, birds or the stars. Ferns form an interesting line of study. There are not so many species as to greatly confuse the learner, yet enough to occupy his attention for a long time. Some species are very common and are found on almost every walk in the woods, while others are scarce enough to lead one far afield. A few are so rare that to find one is the thrill of a lifetime.

The author, Farida A. Wiley, has been a student of ferns all her life. She has traveled hundreds of miles to observe certain species in their native habitats and to secure specimens for study and illustration. She is Director of Field Courses in Natural History given by the American Museum, and also Director of Nature Study Courses for Teachers given by the same institution. This fern book is not only dependable and reliable, but it is attractive.

Every fern is illustrated. The lower pinnae of all the larger species are shown, life size, on the left hand page. This is a new departure in fern books. The species can usually be determined by the shape and size of the lower pinnae. The entire frond is shown on the right hand page, reduced of course to scale (sometimes smaller than one would desire) showing the comparative size and shape of an average specimen.

The fronds of small species are shown life size. The illustrations of all but four rare species were made from specimens collected by the author. Sixty-four species, all told, are recognized. Line drawings show the shape and placement of the spore cases of each species and cross sections of the stems, which show pattern arrangement of the vascular bundles.

The author, in her description of each species,

points out its chief characteristics, tells where and how it grows, how to distinguish it from other similar species with which it may be confused. The volume contains a key based on sterile fronds and a complete index of common ferns and scientific names.

This handy manual, popular, yet scientific, should be the companion of the fern lover on his tramps afield.

OLIVER P. MEDSGER.

THE COVER THIS MONTH

The prehistoric cave design from which the cover was taken became known to science in September, 1901. The background in silver is from a photograph of the actual rock in which the figures are carved; while the outlines in blue and red are a faithful reproduction of the design itself. The palaeolithic cavern in which it was found (Les Combarelles) is in the archaeologically famous Dordogne region in southwestern France. Exactly how many thousands of years ago the primitive artist incised this design in the stone cannot be said, but there is no doubt that it represents a very early period in the history of human art. A number of animals now extinct are depicted in the same cave. The people to whom the design is ascribed hunted the wild horse extensively, but there is no definite evidence that they domesticated it.

The horizontal lines crossing the flank of the larger horse have been taken by some to represent a serpent, but it is more likely that a thrust spear is intended. From the pointed end of it a deep groove ending in a hook extends downward, and this may represent blood flowing from the wound.

"Relief" in the Sub-Arctic

(Continued from page 291)

and pauperized recipient of Government rations with every interest in life destroyed.

Within a quarter of a century the caribou herds have been reduced from approximately thirty million to three million. The musk oxen have been almost exterminated. And for years the same thing has been happening to the Little Brothers of the Wilderness—the fur-bearing animals that are the economic life-blood of an area of a million and a quarter square miles. Soon the Far North is liable to be deprived of that animal life that makes existence possible and the natives to become burdens on the palefaces who deprived them of their land and the means to make a living. Surely our economic machinery must be out of gear when we can calmly contemplate these conditions, even in the very shadow of the pole, and see the results of selfishness and the fruits of thoughtless exploitation.

Science in the Field and in the Laboratory

Alberta—British Columbia Expedition—Anthropology News—Christmas Lectures—Newsom-Watson Expedition

The 1936 Alberta-British Columbia Expedition

Our knowledge of the mammal life in the vast territories of the Northwest is limited owing to the inaccessible nature of this country. While it will be some time before the Museum can expect to get a representative series of the mammalian life in Western Canada, it is extremely gratifying to be able to report the acquisition of 500 specimens from Southern Alberta and British Columbia.

The 1936 Alberta-British Columbia expedition returned in September after two months in the field. The members of the expedition were Mr. Colles Stowell and Mr. Wilbur Sawyer, who not only generously contributed financial aid but were of valuable assistance in the capture and preservation of the specimens, and T. Donald Carter, Assistant Curator, Department of Mammals, Museum representative and official collector.

Despite restrictions due to great forest fires, the expedition was able to carry through its plans to ultimate success. The main camps were established at Maycroft, Alberta, at an elevation of 4,700 feet, and at Tornado Pass, 7,000 feet elevation, this camp being on the great divide which forms a boundary between the provinces of Alberta and British Columbia. Later collecting was carried on near Twin Butte, Alberta, at an elevation of 4,000 feet, on the boundary of Waterton Lakes Park.

Among the interesting collection of small mammals, including water shrews, coneys, lemming mice and other species, was a series of Richardson's meadow mouse (*Microtis richardsoni*), new to the Museum collection. This is a Northern race of the largest of the American meadow mice, one of the series measuring over ten inches from tip to tip.

Department of Fishes

At the annual meeting of the American Society of Ichthyologists and Herpetologists, held in Ann Arbor, August 31 to September 2, Dr. William K.

Gregory was elected President for the coming year.

Dr. Rodolpho von Ihering, head of the Comissão Technica de Piscicultura of northeastern Brazil, has returned to Fortaleza. Dr. von Ihering attended the meetings of the American Society of Ichthyologists and Herpetologists at Ann Arbor, and the American Fisheries Society at Grand Rapids, after which he spent a month in New York using the facilities of the New York Aquarium, the Museum library, and the Department of Ichthyology in connection with his researches on the embryology of certain families of South American fishes.

Mr. G. M. Phelps, Jr., has presented the Department of Ichthyology with an interesting document in the form of the broken sword of a broad-bill swordfish projecting some 18 inches diagonally through a three-quarter-inch plank from the bottom of a small boat. According to Mr. Phelps, who was in the boat off Montauk, the swordfish had been harpooned and brought to within about 15 feet, when it drove its sword through the boat's bottom and then broke it off in struggling to free itself.

Anthropology News

One of the most important and extensive projects of the Department of Anthropology in the past twenty-five years has been a comprehensive study of the life and culture of the Plains Indians living in the United States and Canada. As a part of this study, Doctor David Mandelbaum was engaged to carry on two field studies among the Cree Indians of Canada under the direction of Doctor Clark Wissler. During these field trips Doctor Mandelbaum accumulated important information on the former culture and history of the Cree as well as data which will make possible a classification of the numerous bands of this tribe. Doctor Mandelbaum is now at the Museum completing for publication a final report on this work. Under a fellowship from the National Research Council he expects to leave in December for India, where he will make ethnological studies among the Toda.

Jointly with the University of Alaska, the Department of Anthropology has undertaken an archaeological project in Alaska. Its main objective has been to determine the further occurrence of artifacts of a type similar to those found in Mongolia by the Museum's Mongolian expeditions and recently discovered in the vicinity of Fairbanks, Alaska. To this end, Doctor Froelich Rainey, of the Faculty of the University of Alaska, and well known for his archaeological work in Porto Rico, made a reconnaissance last summer along the lower Ranana and Upper Yukon rivers. He reports a successful exploration trip which has resulted in the location of many dwellings, sites and refuse heaps, the trial excavation of which is very promising.

As guests of the Department of Anthropology, two important conference groups met in the Museum. One was concerned with Anthropological exploration in South America; the other was called by the National Research Council, Washington, D. C. to develop a plan for the extension of psychiatric research to Indians and other representatives of the less literate peoples of the earth. The object in this case is to learn something about the personalities of individuals living under conditions we speak of as less civilized. It remains to be seen whether what we call personality is the result of the life one lives or comes about through some inborn characteristic. Among the members of this conference were Adolph Meyer, Johns Hopkins University; Edward Sapir, Yale University; Madison Bentley, Cornell University; H. S. Langfeld, Princeton University.

Chinese Amphibia

Dr. Alice Boring, Professor of Biology at Yenching University, is on sabbatical leave from that institution and has taken up residence in the Department of Herpetology. She is making a study of the amphibian of China utilizing the large collections brought back from the Central Asiatic Expeditions. Dr. Boring is well known for her numerous publications on the Amphibia of China. It is planned that the present study will be a complete account of the known forms.

An Apology

In connection with the article "The Eclipse in Kazakhstan" by Dr. Clyde Fisher in the October number of *NATURAL HISTORY*, the author wishes to call attention to an oversight. In discussing Prof. P. A. Manteufel's investigations of the behavior of animals during an eclipse of the sun, he regrets that he quite inadvertently forgot to mention the work of several well-known American naturalists. The results of the latter were published in the *Proceedings of the American Academy of Arts and Sciences*, Vol. 70, No. 2—March, 1935. The paper is entitled "Observations on the Behavior of Animals During the Total Solar Eclipse of August 31, 1932," and was written by William Morton Wheeler, Clinton V. MacCoy, Ludlow Griscom, Glover M. Allen, and Harold J. Coolidge, Jr. It is hoped that the oversight will be excused, the au-

thor states, as it was wholly unintentional and quite inexplicable.

Doctor Camp's Trip

Friends of the Museum may be interested to hear that Dr. C. L. Camp, formerly of the Departments of Comparative Anatomy and Ichthyology, has recently returned from a profitable trip to Europe and Africa. He succeeded in obtaining a number of interesting examples of mammal-like fossil reptiles from both continents, and made a study of museums in London, Berlin, Paris and elsewhere. He is now director of the Museum of Palaeontology of the University of California.

Fellowship for Doctor Murphy

Dr. Robert Cushman Murphy, of the Department of Ornithology of the American Museum, was elected to corresponding fellowship in the German Ornithological Society at its fifty-fourth congress, held at Bonn last July.

Peruvian Archaeological Collection

The Museum expedition to Peru (December, 1935 to August, 1936) conducted by Dr. Wendell C. Bennett, Assistant Curator of Anthropology, has furnished the Natural History Museum with a large collection representing several localities and civilizations on the north coast of Peru. The collections come principally from the valleys of Viru and Lambayeque.

The collection consists largely of pottery, both plain and decorated, but also contains specimens of copper, bronze, stone, bone, shell, wood, gourd, and fragments of textiles. Elaborate mortuary pottery and utilitarian cooking and drinking vessels which were found side by side in the same grave indicate that the prehistoric Peruvians not only placed articles of artistic merit and value with their dead, but also followed the more realistic custom of providing food and drink for the journey to the land of the dead.

One group of vessels and artifacts represent the Early Chimú or Muchic civilization, considered the oldest on the north Peruvian coast. This civilization is generally considered to have existed during the first five centuries after Christ. Although the earliest civilization yet discovered in this region, it is by no means primitive in any sense of the word. The clay vessels representing modeled portrait heads, the figure and animal modeling, and the faithful reproduction in clay of everything from houses to food plants are the finest examples of clay modeling to be found in the Peruvian civilizations. Furthermore painted scenes on vessels are not only admirable as artistic achievements, but are valuable in portraying excellent pictures of the life and customs of the times.

A second group of vessels and artifacts represents a civilization or period which follows the Early Chimú. Many characteristics of the previous civilization still persist, but mixed with them is a definite influence from the region of Recuay in the highlands of Peru. This combination of Highland and Coast civilizations to form a new type, neither

one nor the other but influenced by both, is of archaeological importance because the geographic features of Peru intensify regional differences, especially between the coast and the mountains, and make inter-regional chronologies difficult to establish.

Other vessels represent an influence from the south typified by designs painted in black, white, and red colors. Finally a large percentage of the collection is of black pottery so characteristic of the Late Chimu period which preceded the Inca civilization on the coast of Peru. Graves of the last two periods (the Red-White-Black and the Late Chimu) were found in an abandoned habitation site of the Early Chimu period, thus furnishing further proof that the Early Chimu is truly Early.

The collection from Lambayeque valley is the only documented material known from the Far North Coast region of Peru. Consequently it will be of importance in classifying other collections from that region which have been made by untrained treasure-seekers who pay little attention to records of their work.

This collection is now being catalogued prior to more thorough study and more detailed conclusions.

Doctor Pinkley's Brain Research

Dr. George Pinkley, of the Department of Comparative Anatomy, and Mrs. Pinkley have returned to New York after four years abroad. They remained in London for more than two years, where Dr. Pinkley made research studies in comparative anatomy, vertebrate palaeontology, and anthropology with especial reference to the evolution and phylogenetic history of the human brain. These studies, which were partly in the interest of the James Arthur Foundation for the Study of the Evolution of the Human Brain, were made in the laboratories of Professor Sir Grafton Elliot Smith and Professor D. M. S. Watson of the University of London, and at the British Museum (Natural History). After leaving London, Dr. and Mrs. Pinkley were in Egypt for a short time, visiting the fossil deposits of the Fâyum desert basin, where remains of the oldest known anthropoids have been found.

In China, Dr. Pinkley, assisted by Mrs. Pinkley, continued his studies on the brain at the University of Hong Kong and at the Peking Union Medical College. They were also guests of the National Geological Survey of China at the Cenozoic Research Laboratory and at the excavations at Choukoutien, where specimens representing at least twenty-four individuals of the famous fossil Peking Man have been found. On a trip to Borneo and the Philippine Islands, the Chinese Geological Survey cooperated in sending Mr. Bien Mei-nien of the staff of the Cenozoic Laboratory with Dr. and Mrs. Pinkley. Here they collected specimens of smaller primate and insectivorous mammals, especially for Dr. Pinkley's researches on the brain; and in addition, made a reconnaissance exploration of cave deposits which might yield further evidence of fossil man in the Far East.—W. K. G.

Jonker Diamond

We have been informed that, contrary to the impression given in the October issue of *NATURAL HISTORY*, the Jonker Diamond was displayed not only at the American Museum but also at the store of the Grogan Company in Pittsburgh.

Junior Astronomy News— Christmas Lectures

The annual Christmas science program of The American Institute Student Science Clubs will be held as usual at the American Museum on December 28 and 29. Participation in this program is open to all of the Institute's member science clubs in New York City and suburbs.

The Christmas Lectures will be held at noon on each of these days, with two world famous scientists or explorers speaking on each program. This year Dr. Harlow Shapley of the Harvard College Observatory will speak. And either Dr. Hugo Eckener or Captain Lehman of the new German dirigible "Hindenburg" will also appear. The other two speakers will be announced at a later date. These lectures will be broadcast over a national hook-up so that all science clubs and all young people interested in science over the country may have the opportunity of hearing them.

The Christmas Lectures are modeled somewhat on the Christmas series held by the Royal Institution of London for over a century. The British series have been conducted by such brilliant scientists as Faraday, Tyndall, Bragg and others. It is the plan of The American Institute to provide an opportunity for the young people of America also to hear the world's great scientists. In the past two years such men have appeared on the Institute program as: Dr. Harold C. Urey, Nobel Prize Winner in Chemistry; Dr. W. F. G. Swann, Director of the Bartol Research Foundation of Swarthmore; Captain A. W. Stevens, Commander of the 1934 Stratosphere Flight—the highest ever made, and others.

The Science Congress for clubs will also be held on these two days. The Congress plan is based on meetings of the American Association for the Advancement of Science, with section meetings on a variety of science subjects held simultaneously. At these meetings members of the clubs read papers or give demonstration talks of their researches in the clubs during the school year. A junior club member acts as the chairman of each meeting and leads the discussion which is invited after each paper is read. Prominent scientists are asked to attend the meetings as an honor to the speakers, but they take no part in the program which is conducted entirely by the boys and girls themselves.

In the past papers of great merit have been presented. And meetings on many specialized subjects have been arranged, including such general topics as: Genetics, Microscopy, Cinphotomicrography, Photomicrography, Electrified Gases, Light Waves, Vacuum Tubes, Aerodynamics, Airplane Construction, Chemistry of Visible Particles, Applied Chemistry, Combustion, Biology, Biological Preparations, etc.

Newsom-Watson Anticosti Expedition

The Newsom-Watson Anticosti Island Expedition of the American Museum of Natural History has just returned to New York after studying various forms of animal life on Anticosti Island, which, from a natural history standpoint, has been more or less a question mark until the present time.

Anticosti Island is 135 miles long and 40 miles wide, and lies in the entrance to the Gulf of St. Lawrence, Province of Quebec, Canada. This 3000 square miles is one and a half times as large as Prince Edward Island, yet no detailed complete topographical survey has ever been made of the island, except along the coast and by timber cruisers inland.

In a preliminary report submitted to Dr. Roy Chapman Andrews, Director of the American Museum, Mr. William M. Newsom, leader of the Expedition who was accompanied by Mr. Earl S. Watson, said:

"The Newsom-Watson Anticosti Island Expedition of the American Museum of Natural History arrived at Anticosti Island on September 15th, after being held up for three days at Riviere aux Renards in the Gaspé Peninsular on account of gales.

"At Port Menier three deer were taken; the skulls and skins prepared for the Museum. Also, one complete deer skeleton was taken and is being shipped to the Museum.

"At Port Menier a good deal of time was spent taking the speed of the deer with a stop watch. This work was done on the open fields near Baie St. Claire. When a deer was found in a favorable position, a shot was fired under it. The bullet tossed gravel on the deer and marked the spot where the deer started. As the deer reached the edge of the field, or passed a mark such as a stone or tree that could be identified later, his time was taken and the distance measured with a tape. Figures will be available later, but we can say now, the deer is not going nearly as fast as he appears to be and many a hunter will find his alibis for missing a deer are not as sound as they were heretofore. This is the first time the whitetail deer has been clocked with a stop watch.

"Experiments were also made at Port Menier with camouflaged clothing as compared to ordinary hunting dress, to ascertain how well the deer can see the hunter and what effect the hunter's dress has on his success. It was not difficult to find deer on which to experiment, as we counted as high as 72 deer in one day.

"On leaving Port Menier, we went along the North shore of the island in a 32-foot boat making various stops along the way. There are many seal along the shore and four of these of various sizes up to 7 feet long were taken and the skins and skulls sent to the Museum.

"At Vaureal River, about 100 miles run from Port Menier, we secured a fine black bear, the skin and skull of which is being shipped to the Museum along with several other skulls collected at points where bear has been shot in the past.

It is, of course, too early to say whether or not this is a new sub-species of black bear. But we find the often published story that the island has a new variety of very large brown bear is a myth.

"Up Vaureal River, we went inland to the falls—170 feet high—and made camp there, making excursions to the plains above the falls.

"Regarding small mammals, there are fox—red, cross, and silver—beaver and other mammals—all protected by the Company that owns the island, and we were requested not to take these as the Company is trying to build up revenue from the proceeds of trapping these. There used to be quantities of marten, but it is said that none are left, although there are rumors of a marten's tracks having been observed in the past year.

"There are no mink, weasel or fisher and neither chipmunk, squirrel, skunks or porcupine have ever been found in the island. There are hares, but we saw none. We collected whitefooted mice. At Port Menier there are house mice and the common Norway rat, no doubt brought in by the boats. There are frogs, but no snakes on the island.

"As far as we could learn, there are no shrews. We took none in the traps and several trappers working for the Company who are familiar with them in other countries, told us there are no shrews in Anticosti. We showed colored pictures of the shrew to several local trappers who were born and have always lived on the island, and they told us they had never seen one. This seemed so amazing to us, we made careful inquiry everywhere we went, but the results were the same in every case—no shrews. There may, of course, be some inland where we did not go.

"We found some ruffed grouse, but they are not very plentiful. We were told that during the hard winter of 1934 ptarmigan came to the island, but left in the spring and have not been seen since that time. Moose are not plentiful—a few only having been seen by the trappers this year. We saw only one track. There are three elk (cows) on the island and they are very tame. The Company was forced to shoot the only bull elk as he became a menace. The Canadian government and the Company have released a herd of reindeer, but they are not increasing rapidly."

Education Notes

The Scholastic Exhibit of drawings, designs, pottery, jewelry will open in Education Hall on November 12th and continue to December 15th. This exhibit has been arranged by Mr. Forest Grant, Director of Art for the Board of Education.

* * *

Mr. John R. Saunders and Mr. Robert R. Coles are continuing their educational radio programs on "Today's Natural History." The talks are given over WNYC on Wednesdays at 4 p. m. and over WHN on Fridays at 12 noon, and will include current news items in the world of natural science. Follow-up tours of Museum halls mentioned in the broadcasts will be made on Saturday afternoons following the talks, at 3 o'clock.

LOOKING INTO MEXICO

If the article in this issue of *NATURAL HISTORY* on the evolution of Mexican art by Dr. George C. Vaillant and the series of photographs of the new motor highway to Mexico City by Charles H. Coles tip the balance for some readers in favor of a trip to that country, it may be interesting to note some of the many historic and scenic attractions that await the visitor there.

Although it is impossible to enumerate in the space of this article the many places of interest in Mexico, the following trips, suggested by Doctor Vaillant, Associate Curator of Mexican Archaeology, may help you to decide what to see first. For the greatest enjoyment it is recommended that the first day or two after arrival in Mexico City be quietly spent becoming acclimated, as the city lies at an altitude of over 7000 feet.

• TRIPS THAT CAN BE MADE IN A DAY FROM MEXICO CITY

1—Using Mexico City as a base and requiring only one day, an interesting trip may be made to the buried city of San Juan Teotihuacan with its remarkable pyramids and partially excavated evidence of a highly developed civilization that flourished a thousand years before the arrival of Columbus in America. The pleasantest way to see San Juan Teotihuacan is to leave Mexico City about eight in the morning and drive directly to the pyramids, arriving at about nine o'clock, before the sun is too hot. On the return trip you may stop at Acolman and the Villa de Guadalupe, have a picnic lunch at El Bosque del Conadero, the site of the former palace of Nezahualcoyotl; thence home by way of Texcoco and Chapingo (affording an opportunity to see the painting by Rivera that is considered his finest work) and the famous walls of Huexotla.

2—One day's sightseeing should include a visit to the National Museum, the Ministry of Fine Arts, the National Theater which contains a copy of the controversial painting by Rivera that once decorated Rockefeller Center in New York, and the Convent of Churubusco, followed by lunch at the San Angel Inn. After lunch you may visit the Convent of San Angel

and Copilco, which is the nearest point to the volcano that once buried this part of the countryside in molten lava and where may be seen the skeletons of human beings interred long before. Here one may also see, caught in the lava flow hundreds of years ago, the pyramid of Cuicuilco.

3—A long morning's trip is the visit to the famous Tacuba Noche Triste Tree, under which Cortez is supposed to have wept over his defeat; the Convent of Tepoztlan, renowned for its very rich churrigueresco, and return by way of Tenayuca, Aztec pyramid, of which there is a very fine model in the American Museum of Natural History.

4—It requires only one day, with a leisurely start, to visit the market at Toluca and the ruins of Calixtlahuaca and on the way back, turn off to see the Convent of El Desierto de Los Leones, and return via San Angel.

• TRIPS REQUIRING TWO OR MORE DAYS

1—A very interesting trip, requiring from three to four days, is to take the train to Morelia, capital of Michoacan. From Morelia you can go to Lake Patzcuaro, surrounding which are the primitive villages of the Tarascan Indians. You can boat on the lake and visit the Island of Janitzio and the ruins of Tzintzuntzan, once the capital of the great Tarascan empire. This trip could include a visit to the famous gardens of Uruapan, two and a half hours away by train.

2—At least four days should be devoted to the trip to Puebla and Oaxaca. Puebla may be reached in two and a half to three hours from Mexico City. The beautiful altar in the Convent of Huexotzingo should be visited en route, also the famous pyramid of Cholula may be seen on the way to Puebla. Puebla is interesting for its many churches, its cathedral and its potteries; Cholula, for its pyramid and the Church of San Francisco Acatepec—renowned for its beautiful tiles.

From Puebla one may take the train to Oaxaca. As this requires a very early morning start, some people prefer motoring to Tehuacan for the night and boarding the train for Oaxaca next morning at a reasonable hour. Oaxaca, which is an interesting old southern

city and Indian market, is the starting point for trips to the ruins of Mitla. These are prehistoric and of wonderful design, with monoliths, intricate mosaics, mural decorations and many hieroglyphics. They were old when the Spaniards first saw them 400 years ago. From Oaxaca a visit may be made to Monte Alban and the Church of Santo Domingo. Return by Pullman to Mexico City.

3—Two or three days should be allowed for the trip to Cuernavaca. If you go by motor you can leave in the morning, taking the long route via Cuauhtla and en route, see Chalco Lake, with its Aztec communities and lake life; the famous open chapel of Tlalmanalco Convent; Ameca-meca with its views of volcanos, and Yautepec, the home of Zapata. Cuernavaca, by the short road, is only forty-four miles from the capital and the scenery, whether one goes by car or train, is some of the finest in Mexico.

The points of particular interest in Cuernavaca are the palace which was built by Cortez in 1530, and the Cathedral. From Cuernavaca you may make a day's excursion to the Cacahuamilpa Caverns and, on the way, stop at the Xochicalco ruins, so old that all knowledge of its builders had been lost before the advent of Cortez. The return to Mexico City may be made by the short route mentioned above.

4—Yucatan. As there is no railroad to Yucatan, the trip must be made by plane to Merida. There is a regular plane schedule by a subsidiary of the Pan-American Airways. With Merida as a base, you can motor to the ruins of Chichen Itza, Uxmal and Kabah Labna and Sayil. (If you travel in Yucatan it is advisable to carry a small bottle of gasoline which, when daubed with cotton, is an effective means of extracting the ticks which infest that part of the country.)

• TRANSPORTATION BY RAIL

Travel from any point in the United States to Mexico City is convenient and luxurious. By the Southern Pacific or Missouri Pacific Railroads you can reach one of the main gateways to Mexico and on the same Pullman, be carried across the border and, via the National Railways of Mexico, to Mexico City. Through sleeping car service is operated daily from St. Louis, Missouri, and San Antonio, Texas. The

train leaving St. Louis at 6.30 P.M. arrives at San Antonio the following evening. By breakfast the next morning you have crossed the Rio Grande at Laredo and are speeding through Northern Mexico, arriving at the capital the following evening. Customs inspection at the border is made on the trains.

The National Railways of Mexico now provide high-class Pullman sleeping car service with standard Pullmans north of Mexico City and Pullman-built sleepers, designed for the narrow-gauge railroad lines, south of the capital. Meal service includes fully equipped cafe and broiler buffet cars under the management of the Pullman Company. The ticket agents at principal points and most of the conductors speak English. The trip via any one of the several different routes from the border to Mexico City is varied and interesting.

• RAIL-PLANE

For those whose time is limited there is a daily airplane service maintained by the Mexican Aviation Company—a branch of Pan-American Airways, Inc.—between the border and Mexico City. A twelve-passenger plane, with a crew of two pilots, radio operator and courier, leaves Brownsville, Texas each morning at 8:30, arriving at the capital at 1:30 P.M.

• BY WATER

The Grace Line, the New York and Cuba Mail Steamship Company, and several smaller lines operate ships between the United States and Mexico. For those who have the time, the trip to Mexico by sea is the pleasantest.

The New York and Cuba Mail Steamship Company operates the most direct line from New York to Mexico stopping at Havana, Cuba, and Progreso on the way to Vera Cruz. It is also the only way to get to Yucatan without flying, except via New Orleans. The Grace Line's luxurious new ships sail on a bi-monthly schedule between New York City and the port of Mazatlan on the west coast of Mexico. Also, from San Francisco and Los Angeles, California, to Mazatlan. The ships sailing from New York stop at two ports in South America, Panama, through the Canal to Costa Rica, El Salvador and Guatemala. This trip takes thirteen days from New York City to Mazatlan. From San Francisco to Mazatlan

takes four days, with a stop at Los Angeles on the second day. The Grace Line also make a round trip arrangement whereby one may go one way by rail and the other by boat. They will carry your automobile at a not exorbitant rate.

However, all types of automobiles can be hired in Mexico. Fords with drivers can be rented for approximately twenty-five cents in American money for each city trip in Mexico City. Larger cars cost from approximately seventy-five cents to a dollar and a half (American) per hour. In other cities and towns the transportation arrangements are similar to those in the capital, though less extensive and often a little cheaper.

Since schedules and facilities are liable to fluctuate, the prospective tourist is advised to consult an accredited travel agent for detailed information.

• CLIMATE

Although Mexico has a variety of climates, depending mainly upon the differing altitudes, the greater part of the country has a summer temperature of approximately 71°F for the warmest month, and perfect autumn weather all winter. There is a narrow strip of low country along both coasts that is very hot; then a quick rise in terraces to the great plateau 1500 miles in length by 530 in breadth, with a mean elevation of about 5000 feet above sea level—Mexico City is 7349 feet. Above this, rise the snow-capped Sierra Madre Mountains.

There is never any snow in any of the cities or towns of Mexico that the average tourist visits. The mercury rarely approaches the freezing point even in Mexico City. The mid-year months are cool and delightful all over Mexico except along the sea shore. The rainy season on the Mexican plateau is between June and September but the showers usually occur in the P.M. with clear days. April and May are the dusty season and not as pleasant as other months.

• CLOTHES

If you intend to visit Vera Cruz, Tampico, Manzanillo, or other coast towns, you will find very light clothing, suitable for the tropics, necessary for your stay in those parts. For the rest of the time, ordinary fall clothing, with a light coat for the cool evenings, will be most comfortable. The hotel dining rooms and restaurants in Mexican cities do not require evening dress, which is reserved for private social occasions.

• WHAT TO BUY

The Mexican Government will not allow Mexican relics of historical value to be taken out of the country, except by official permit obtainable at the Department of Historical Monuments, and they are watched for during the inspection of baggage at the custom-house. However, there are many interesting pieces, old and genuine but not of historical value from the government's viewpoint, which can be taken out without difficulty.

The most popular purchases are: drawn work from Mexico City, Queretaro, Aguascalientes and Celaya and pottery from Mexico City, Guadalajara, Puebla, Cuernavaca and Oaxaca. Each of these cities has considerable fame for its own particular product, the Guadalajara ware being perhaps the finest. Stones may be purchased in the following places: Queretaro for opals, Puebla for onyx and Mexico City for jade beads, masks and ornaments taken from the old Indian tombs of Mexico. In Mexico City also are marketed the turquoises mined near Zacatecas. Sarapes—the Indian blanket of Mexico—sombreros, palm hats and lace mantillas are other popular purchases. Some of the latter are made in Mexico but the finest are imported from Spain. Decorative articles to be collected in Mexico include lacquer work, silverware and paintings by modern Mexican artists. Useful souvenirs are baskets, sandals of leather (if well cured) and straw hats; in Yucatan, hammocks.

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BULLETIN

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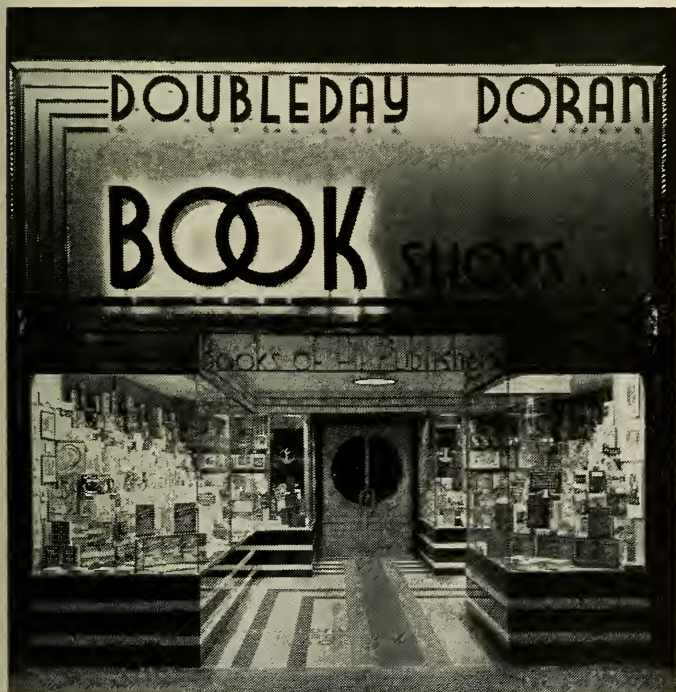
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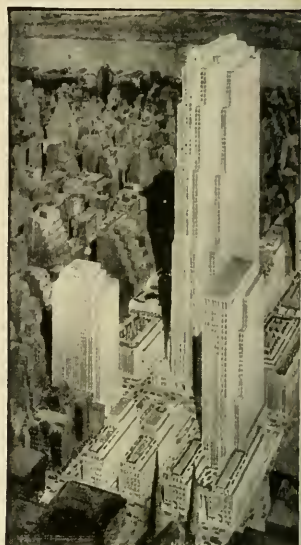
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ORANG-UTAN OF BORNEO

Weighing an estimated 300 pounds, the spectacular creature recently brought back by Martin Johnson, is perhaps the largest orang-

utan ever captured. Being a mature adult, he will never abandon his jungle habits, and will thus make a valuable subject for scientific study

The Master Key to Oil

How the petroleum geologist locates buried reservoirs of "liquid gold," using microscopic fossils as clues

By BROOKS F. ELLIS

New York University

FAR below the earth's surface a huge steel drill dangles at the end of a half mile of cable. Endlessly it plunges up and down, punching a hole ever deeper into the earth in quest of hidden reservoirs of petroleum.

A 3000-foot well often costs as much as \$30,000. Will that \$30,000 pay for a dry hole in the ground or for a new fortune? What assurance is there that oil reservoirs exist in any particular locality? Can this be determined from the surface?

"Oil smellers"

Since the days of Drake and his Titusville well, many answers have been given to these questions by a great variety of people. An endless procession of "oil smellers," divining rod experts, peach twig manipulators and assorted quacks have offered their services to oil prospectors at a price. In one celebrated instance, a peach twig expert grasped the forked stick of his cult and after an appropriate wait solemnly pronounced, "There is no oil here." Unknowingly he stood directly over a bruised pipe line transporting oil in a six-inch stream. Again a "smeller" walked across a field, drove a stake and on that spot a hundred-barrel well was brought in. In the next valley he subsequently located a dozen dry holes.

Endlessly these instances were multiplied, with the law of averages getting in its deadly work, until most producers were driven to the verge of apoplexy by the mere suggestion that anyone could help them locate oil well sites.

Small wonder then that they turned a deaf and stony ear to the geologist's suggestion that he might be able to reduce the hazard. Nor was their attitude particularly softened by the fact that the early attempts of geologists weren't anything to brag about. Gradually, however, they were forced to admit that the application of scientific principles and geologic knowledge did materially reduce the number of failures. The large companies were the first to recognize this and to establish geologic departments to guide them in the search for petroleum. Smaller companies and individual operators followed their lead more slowly; and by the second decade of the present century the value of the geologist to the industry was well established.

The petroleum geologist did not rest content, however, but continued diligently to improve his methods and to search for a master key to his problems. What he wanted was some means by which he could get a picture of subsurface conditions, much as the X-ray guides the operating surgeon.

In sedimentary rocks

The oil-bearing rock layers are nearly always of the sort that have been laid down as sediment in bodies of water. Subsequent to their formation, these rock layers have been buried beneath other accumulated beds; and continental uplift has in many instances raised them far above the surface of the sea, so that rock layers containing petroleum are often found hundreds of miles from the present oceans. These reservoir rocks are chiefly sandstones or porous limestones, although considerable oil has been produced from conglomerates and shales. In the sandstones, the oil

occupies the space between the grains of the rock not filled in by the cementing material. This space would appear, on first thought, to be too small to accommodate much liquid; tests have demonstrated, however, that up to 40 per cent of the total bulk is porous in some sandstones, although the average is about 16 or 17 per cent.

Sedimentary rocks cover three quarters of the land area of the earth and extend far underground in complicated series. Most of them do not contain any oil, but some hold oil worth millions of dollars. The petroleum geologist's problem is to determine whether beds that have elsewhere proved to be petroliferous lie below, and if such is the case, where they can be tapped to best advantage by drilling.

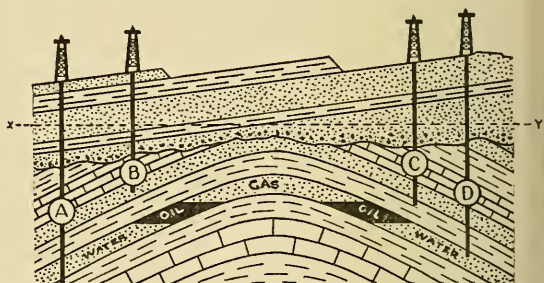
In determining what beds underlie a particular area the geologist makes extensive use of the Geologic Column. This is a sort of master chart, containing all of the formations or layers of the earth's crust with the oldest at the bottom and the youngest at the top. By studying the rocks exposed in mountain sides, canyons, mine shafts, tunnels and drill holes, geologists have been able to determine the succession of beds in the various areas examined. These local succession charts were then combined to form the master chart.

Dating the rock layers

Fossils have been one of the most important tools used in correlating beds from various areas and placing them in their proper order in the Geologic Column. They are the remains of plants or animals that lived in the prehistoric seas when rock-forming sediments were being deposited, and sank to the bottom along with inorganic sediment and so were buried and preserved. Certain of them serve the geologist as labels in establishing the age of the rock layers. By using these index fossils the petroleum geologist is able to identify the surface rocks in his area and to ascertain how they fit into the Geologic Column. Through inspection of the column he is then able to say whether beds that have elsewhere proved to be petroliferous may lie below.

But the location of productive well sites depends not only on the existence of petroliferous rocks but also upon structural traps in them capable of causing the accumulation

of oil in one place. A glance at the accompanying diagram will show one of the commonest and most important types of oil trap. It is a wave-like arch in a series of layers produced in times long past by continued pressure. Natural gas and oil accumulate in this type of trap because both of these substances are lighter than water, which is the commonest occupant of sedimentary rocks. All too often for the producer's peace of mind the driller encounters salt water; whereas the oil, which rises above the water and the gas that rises still higher is usually found where it has been caught in a structural trap. Another important type of structural trap is the dome.



HOW "FORAMS" LOCATE OIL

The search for buried reservoirs of oil is a search for traps in the rock layers. Identical microscopic fossils from drill samples at points A, B, C, and D reveal the presence of a dome-shaped structure contributing to the accumulation of oil and gas as shown

This is really a modification of the arch or anticline; in it, as the name implies, the layers have been bulged upward to form a dome. Here the accumulation of oil and gas occurs in exactly the same manner as in the elongated anticline. Likewise in other structural traps involving tilted layers, separation under gravity follows the same principles.

Larger fossils useless

Since these structural traps in reservoir rocks are subsurface features, usually not apparent at the surface, how is the geologist to detect their presence? How is he to identify beds that lie far below the surface and to determine their slope? The larger invertebrate fossils, which served in the construction of the Geologic Column and are used in ordinary correlation, are of very little service. Because of their large size they are broken

up by the drill so as to be unrecognizable and of little use in correlation. What then is the precious clue that will unlock the door of the earth's treasured fluid?

The science of physics has been of some service. Instruments have been devised which interpret underground structure to some degree through the behavior of artificially produced earthquake waves or by measuring variations in the pull of gravity. But the value of these findings has been found chiefly in special cases and as checks on other methods.

Though it seemed for a while that fossils had been of little account beyond the precincts of geologic science, the real key to the riddle of petroleum geology was found to lie in a certain kind of very small fossils. In well records and test borings where the usual index fossils are practically useless owing to their being broken up, a group of organisms has come to the rescue of the petroleum geologist as though it were practically made to order. These are the Foraminifera, or "Forams" as they are colloquially referred to, a group of single-celled animals with hard shell-like internal skeletons. They have a wide geographic distribution, and many of them possess the fortunate attribute of having a very narrow range geologically. Combined with these features is the all-important one of minute size, which allows them to escape destruction by the drill. They are the master key to petroleum.

Guide to oil "traps"

Not only do they serve to identify the various layers of rock encountered by the drill, but having done this they enable the geologist to plot the domes, ridges and valleys of buried structures. This he does by comparing the depths at which a key horizon is encountered in the various borings in the area being studied, just as a surveyor plots mountains and valleys from the altitude of selected points. Thus the Foraminifera are the clues to the location of the all-important structural traps.

Certain members of this group have been known for a very long time. In 450 B. C. Herodotus saw the fossilized tests of forms that are now known as Nummulites or "Money Stones." This form is one of the giants of the group since it averages almost an inch in diameter. Owing to the large size of the tests Herodotus was able to observe

the structure and form quite well and from his observations to conclude that they were once parts of living organisms.

The builders of the Pyramids must have seen Nummulites also and wondered what they were, for the blocks used in their construction are composed quite largely of the shells of these animals.

Aside from the giants of the group such as the Nummulites, most Foraminifera are very minute. The average specimen measures less than a fiftieth of an inch in diameter, and for this reason their existence was not suspected until the microscopes of pioneer workers revealed vast hordes of marvelously beautiful specimens. Soon naturalists in many lands became intrigued with the group and hundreds of papers were added to the literature. Interest seems to have reached a peak in 1884 with the appearance of H. B. Brady's monograph describing the Foraminifera dredged up on the scientific voyage of *H.M.S. Challenger*. Since then, other expeditions, in addition to individual efforts and study, have resulted in the accumulation of a vast amount of information on the group. As a result, the limits of the order have been quite accurately established, and more than 12,000 species, grouped under some 1100 genera, have been described and figured.

The basis of this classification is the test or shell-like internal skeleton, the presence of which is diagnostic of the group. It may consist of one chamber or of many chambers arranged according to a fixed pattern which is consistent for any genus but varies greatly between genera. The material of this test may be chitin (a horny substance), silica, agglutinated sand-grains or calcium carbonate. In the latter case it may be clear and glassy or it may resemble unglazed porcelain.

Living "Forams"

Present-day members of this group are almost entirely marine and range from deep to shallow water. Many forms are pelagic and occupy the surface waters of the open sea. Millions of square miles of ocean bottom are covered with the abandoned shells of these animals that have rained down on the slopes of the oceanic abyss where it does not exceed 16,000 feet in depth. This depth has been termed the "Foraminiferal snow line," because

no shells accumulate below it, owing to the strong solvent action of very deep oceanic waters.

Such, then, is the group to which the petroleum geologist turned in his search for sub-surface indicators. Swiftly and effectively he turned the new tool from purely academic tasks to intensely practical ones. All of the wisdom of the old masters was drawn upon and their methods were quickly re-vamped to meet the new needs. To these the practical paleontologist added much in new points of view, methods and technique.

His contributions were especially extensive in methods of handling these tiny fossils. Many ingenious devices and processes were developed to meet practically any condition and state of materials encountered. Some of these are, of necessity, quite complex, but the end result is the same—namely the mounting of specimens for observation under the microscope.

One of the simplest ways of accomplishing this task is first to boil the samples in water to loosen the specimens from the matrix. When this is ineffectual or too slow, ammonium acetate is sometimes added to the water and the boiling is carried to a point where the solution is super-saturated. On cooling, the ammonium acetate, which has penetrated the matrix, crystallizes, and the attending expansion serves to aid in pulverizing the material surrounding the specimens. The sample is then washed in running water and dried, after which it is placed in a sorting dish about three inches in diameter. Next it is examined under the low power of a binocular microscope. Since the field covers only a small portion of the dish, a special mechanical stage is used to insure a complete examination of all portions of the tray. Specimens are singled out and picked up on the moistened tip of a very fine sabel's hair brush, and finally mounted with water-soluble glue on opaque slides. They are then ready for study and final identification.

Through the microscope

This detailed examination is best accomplished when the slide is mounted on a universal stage which permits the specimen to be observed from all sides except that applied to the slide. If a universal stage is not used it then becomes necessary to loosen and re-ce-

ment it on the slide in the several positions necessary to permit complete observation. Since the average size is well below a fiftieth of an inch, the latter method often results in the loss or destruction of specimens.

The larger Foraminifera are exceedingly complex and it is necessary to prepare thin sections of these. This is accomplished by grinding away the specimen on one side until the plane of grinding passes through the structure to be studied, cementing it on a transparent glass slide with Canada balsam, and then grinding away the other side until the desired thinness is secured. The section is then studied under the microscope by means of transmitted light. Many of the larger forms cannot be identified except through study of the internal structure of their tests or skeletons.

Need of "dictionary"

As soon as this new use for Foraminifera was discovered, geologists doing petroleum work found their efficiency greatly increased, especially when dealing with buried structures. Before long, however, it became evident that only a small fraction of the potentialities of these fossils could be realized. This was due to the fact that really effective work with the group depends on access to the literature in which individual genera and species have been described. Here the geologist found a most discouraging situation. Although scientists have been working on this group more than 150 years, their efforts have been individual and more or less independent. Consequently, the descriptions of the genera and species, so necessary to petroleum work, were about as much use as a dictionary would be if the definition of words were written in fifteen different languages, and the various parts of the book jumbled and scattered.

This, indeed, was a major obstacle. Here was one of the finest keys to the problem and yet it could not be used except to a very limited extent. It was like a hundred horse power automobile with a capillary tube for a gas line.

Long before anyone had thought of using Foraminifera for such practical things as petroleum prospecting, the chaotic conditions of the literature had been a source of great difficulty to all workers. By the end of the nineteenth century, the situation had become so

bad that serious attempts were made to remedy it. One of these, Sherborn's great Index to Foraminifera, came out in 1893-96. This work was a distinct advance in that it listed the genera and species that had been described, and indicated where they could be found in the literature. Although this served as an important guide, it still did not overcome the difficulty of securing the literature, nor did it pretend to untangle the hopeless snarl.

Once Foraminifera became important in petroleum prospecting, however, the need for effective action became very pressing. As a result, two great American students of the group set to work on critical studies of the genera, and both published the results of their investigations. Both of these works covered the same field, but from somewhat different viewpoints, and both became important guides to paleontologists. In spite of the excellence of these publications, the fundamental problem of access to the literature was not solved, nor did either scientist attempt the Herculean task of systematizing the more than 12,000 species.

Many languages

About this same time, the author became interested in the situation and envisaged a publication in which the essential parts of the literature would be assembled. Older and more experienced students of the group promptly pointed out the hopelessness of such an undertaking. They emphasized the fact that one person working all of his time could scarcely keep up with the current literature, to say nothing of systematizing the vast bulk of old European writings. Then there was the matter of language difficulties, since the scientific literature of some twelve to fifteen different countries was involved. These were the major barriers, but in addition there were literally hundreds of minor ones that served to make the task even more forbidding and apparently impossible.

Nevertheless, the desirability of such a compilation loomed so large that it was started by the author some eight years ago as a purely private venture. Soon, however, New York University and the American Museum of Natural History became interested in this attempt and lent their aid to its furtherance. The Museum offered its very extensive library as a source of materials, and the University

provided space and equipment. Student assistants, many of them volunteers, gave their time and talents in establishing the foundations of what has later proved to be an enormous enterprise. Of a necessity, the work went forward slowly as none of the individuals engaged in it were able to spend all of their time on this endeavor.

In 1933, however, a few trained people became available through the Gibson Committee which was organized to take care of people deprived of employment by the depression. By examining a great number of these individuals it was possible to single out a few with training and background suitable for the type of work involved. With the aid of these people the work was carried forward for about a year. At the same time very extensive plans were made so that if a large staff later became available the undertaking could go forward effectively and smoothly.

When the Federal Government took over the administration of work relief, an application was made for a project to carry on this research on the literature of Foraminifera. This request was granted, and in January, 1934, a staff of eighty-two people was assembled. After a year had elapsed, a critical study of the results was made, and on the basis of this study a new grant was made in August, 1935. This grant provided for an organization of two hundred people and the necessary supplies and equipment to carry on this complex undertaking. Great progress was made during the next twelve months, and at the end of that time arrangements were made to carry on the work for the additional year necessary to complete the task. The undertaking is now going forward under this present grant, and it is estimated that the manuscript will be ready for the publishers by the fall of 1937.

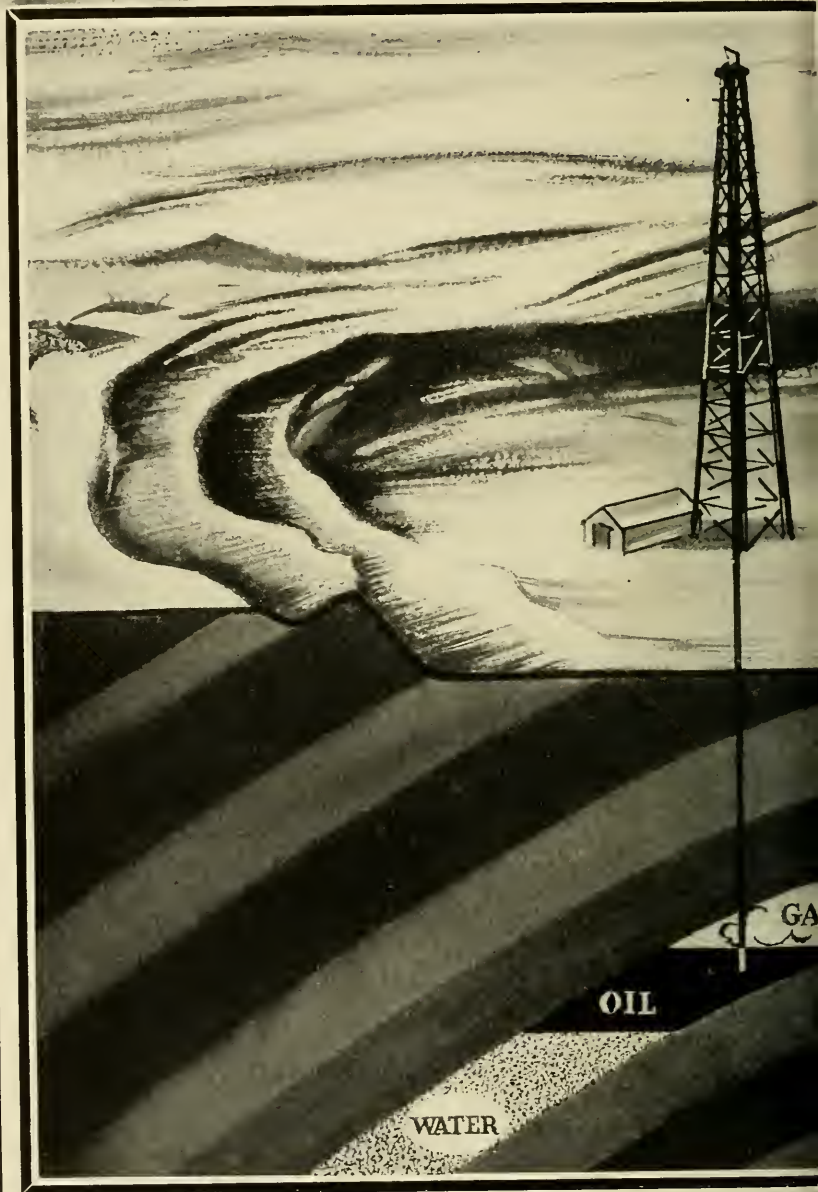
Twenty-five volumes

In this undertaking, the original description, the type figure, locality and level, and other important and significant data relating to each species of Foraminifera is being assembled, integrated and cross-indexed. In addition, all subsequent references are being assembled and appended to each species in chronological order. The same general treatment is given each genus so that both species and

(Continued on page 442)

The Master

FIRST GLIMPSES of the tremendous plan now nearing completion which will enable the petroleum geologist to utilize to their full capacity an



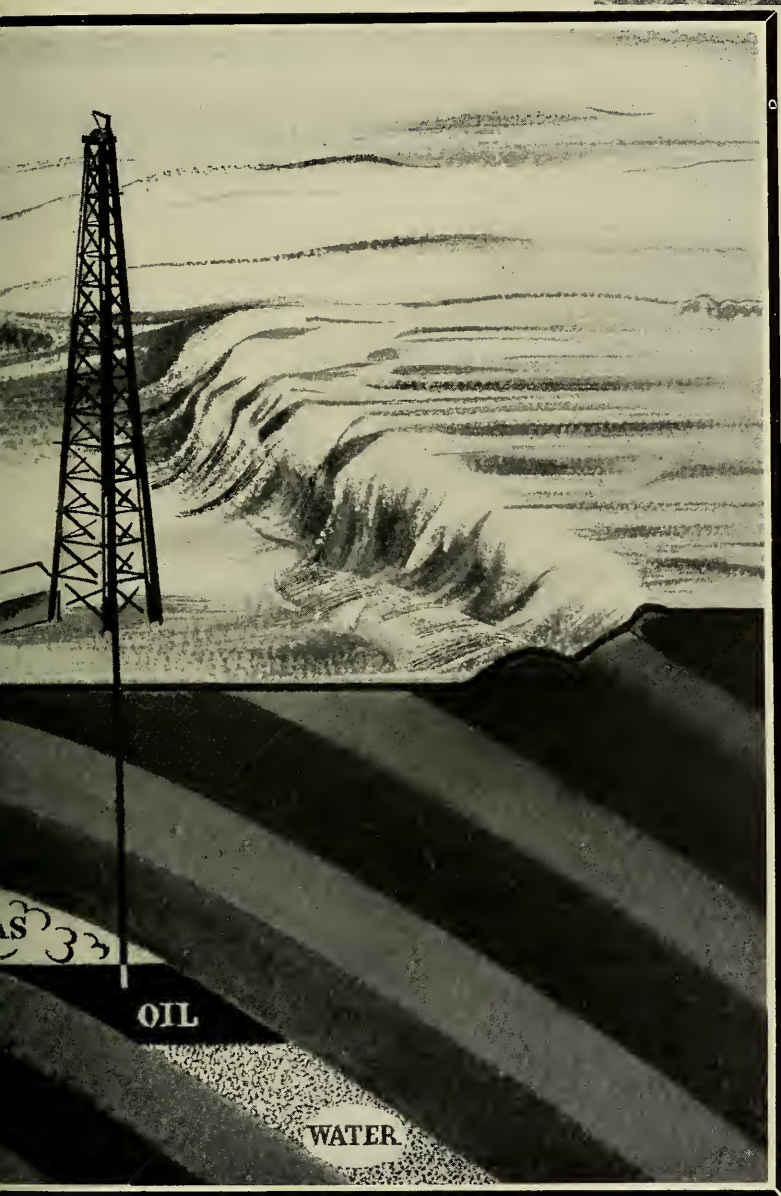
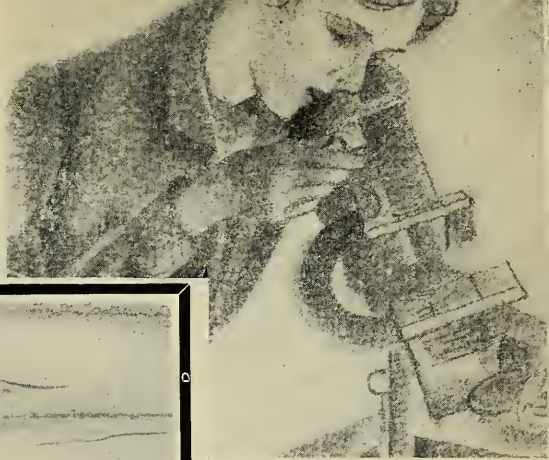
SINCE THE DAYS when oil prospectors believed in the divining rod, science has developed extraordinary methods for locating oil. The latest and most effective is the use of microscopic fossils known as Foraminifera, which speak to the geologist in terms of buried rock structure

Index "Forams" from drill samples, such as are shown on this page, establish the position of the various rock layers in the geological time



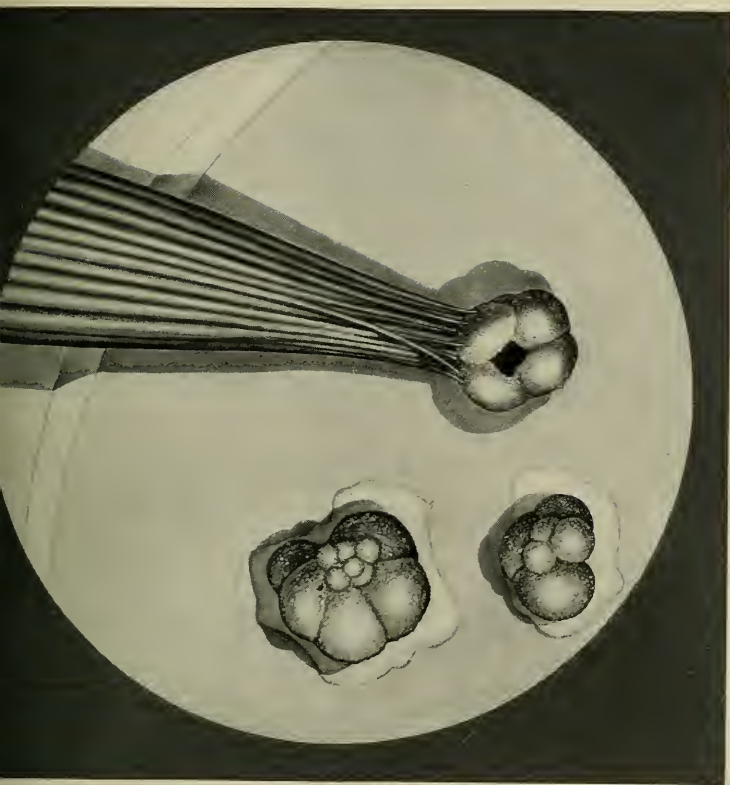
Key to Oil

incomparably valuable set of clues in his search for oil



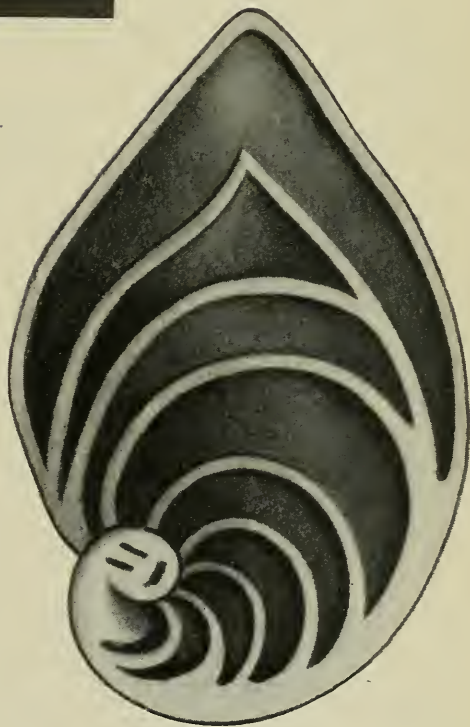
scale, and without actually denoting the presence of oil, enable the prospector to carry his search in the direction of oil-bearing beds. More important still, samples from adjacent drillings reveal the existence of buried folds or domes in the rocks, like the one illustrated above in cross section, in which oil and gas are likely to accumulate. Because oil floats on water, it occupies a high portion in the "trap" shown in this diagram, with the natural gas filling the space at the top





THE CATALOGING of the 12,000 species of Foraminifera by the Geological Research Project under the directorship of Dr. Brooks F. Ellis will provide the petroleum geologist with a 25-volume encyclopedia of these fossils, so important in the search for oil

FROM A WASHED SAMPLE of pulverized rock, shown highly magnified at left, the laboratory technician picks out significant specimens of Foraminifera for mounting and study. The sorting stage of the microscope both rotates and travels horizontally to facilitate selection. As shown above through the microscope the moistened tip of a brush is used for transferring the specimens to the mounting slide on which they are glued



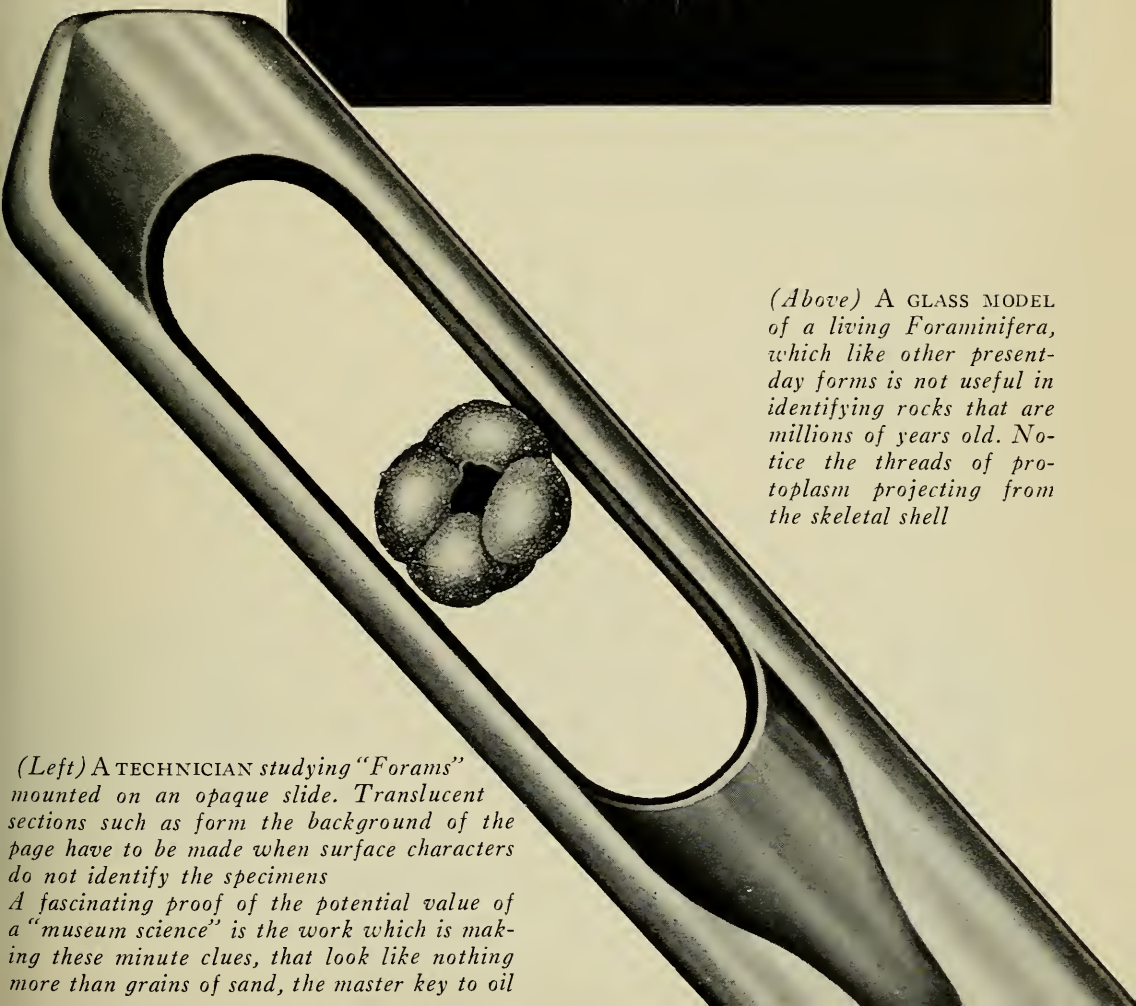
(Right) AN INDEX FOSSIL greatly enlarged. This drawing, like the others accompanying this article, shows the artistic precision that the W.P.A. artists connected with the Project have had to exercise



(Below) ONE OF THE SMALLER *Foraminifera*, placed in the eye of an ordinary needle to show its small size



(Above) A GLASS MODEL of a living *Foraminifera*, which like other present-day forms is not useful in identifying rocks that are millions of years old. Notice the threads of protoplasm projecting from the skeletal shell



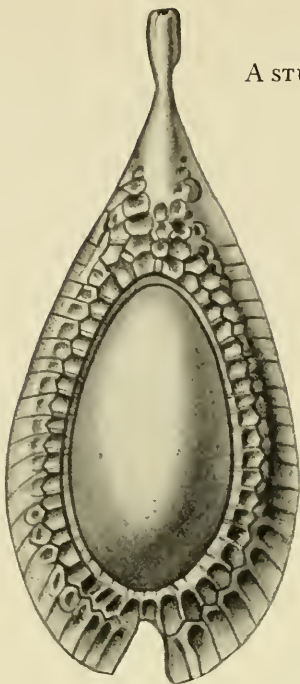
(Left) A TECHNICIAN studying "*Forams*" mounted on an opaque slide. Translucent sections such as form the background of the page have to be made when surface characters do not identify the specimens

A fascinating proof of the potential value of a "museum science" is the work which is making these minute clues, that look like nothing more than grains of sand, the master key to oil

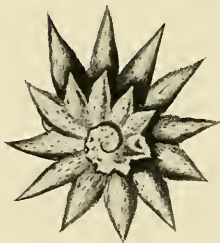
Art Under the Microscope

A STUDY OF TYPICAL "FORAMS"

The rôle of "Forams" in art: aside from their vital importance to paleontology and stratigraphy, this type of tiny organisms constitutes a fascinating study in the fundamentals of aesthetic design

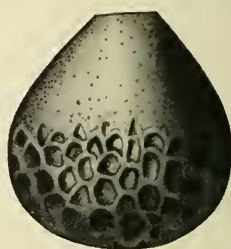


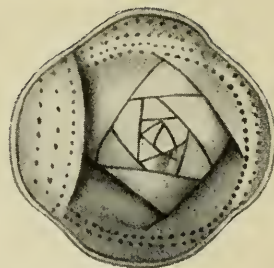
Pendant "Foram": a striking drawing by the W.P.A. artists on the Geological Research Project. These microscopic organisms are of great interest to designers because of the variety of basic aesthetic forms



Starlike "Forams": unusual evidence of their varied formations

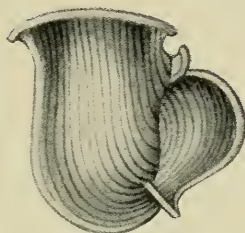
Nature's acorn motif; drop-like "Foram"; and a gourd "Foram"



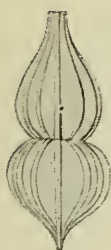


Spiral "Foram" and two types of the rosette structure

The cone, the bell-like contour and the cornucopia design



All these "Forams" represent Nature's most minute conception of line, form and plane. Faithfully rendered as these drawings are from a scientific point of view, the artists have lost nothing of their distinctive aesthetic qualities



In a great many cases these "Forams" combine two or more basic motives as shown in the above drawing



The types shown on these pages represent only a few of the basic aesthetic forms that are expressed by the 12,000 different species of "Forams"

Air Conditioning in Nature

Showing how our nasal chamber is equipped to cleanse and temper the air we breathe, but less effectively than in some animals

By WILLIAM K. GREGORY

*Curator of Comparative and Human Anatomy,
American Museum*

WHEN we have a cold in the head, one of the reasons why we feel miserable is that our natural air conditioning apparatus has been put out of commission. Evolution through countless generations has developed in the nasal chamber facilities for modifying or conditioning every breath of air that we draw.

The modern air conditioning machines used in theaters, stores, offices and homes cool and reduce the humidity of summer air, and filter it. A similar service is performed by the nasal passages.

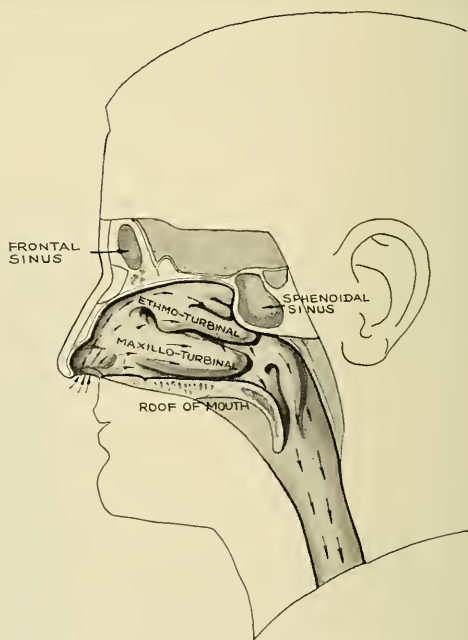
"Radiators"

The air we breathe on a cold winter's day is warmed by contact with a large surface of mucous membrane in the nasal chamber copiously supplied with blood vessels. Though the actual size of the nasal chamber is small, the area of the mucous membranes is comparatively large owing to their being complexly folded, much in the way that the surface of a house radiator is increased by its projecting fins.

The membranes of the nose are kept moist and in this way are prevented from drying and cracking. The air that is inhaled takes up moisture from wet surfaces in proportion to its own lack of it. The mucous itself also helps to cleanse the air of dust. The foreign particles stick to the mucous membrane and are washed off into the passage that leads to the throat or are blown out through the nose. Thus the nasal chamber warms, moistens, and cleanses the air we breathe. The brain is further pro-

tected from extreme cold by the sinuses or cavities which separate it from the cold air that strikes the face and is inhaled.

Man is not as well equipped for the function of air conditioning, however, as many of the lower animals. In certain mammals, such as the members of the family including the badgers, weasels, skunks, mink, otters, etc., the nasal membranes are particularly well developed, and the air that is drawn into the nasal chamber and passes through its "radiators" is

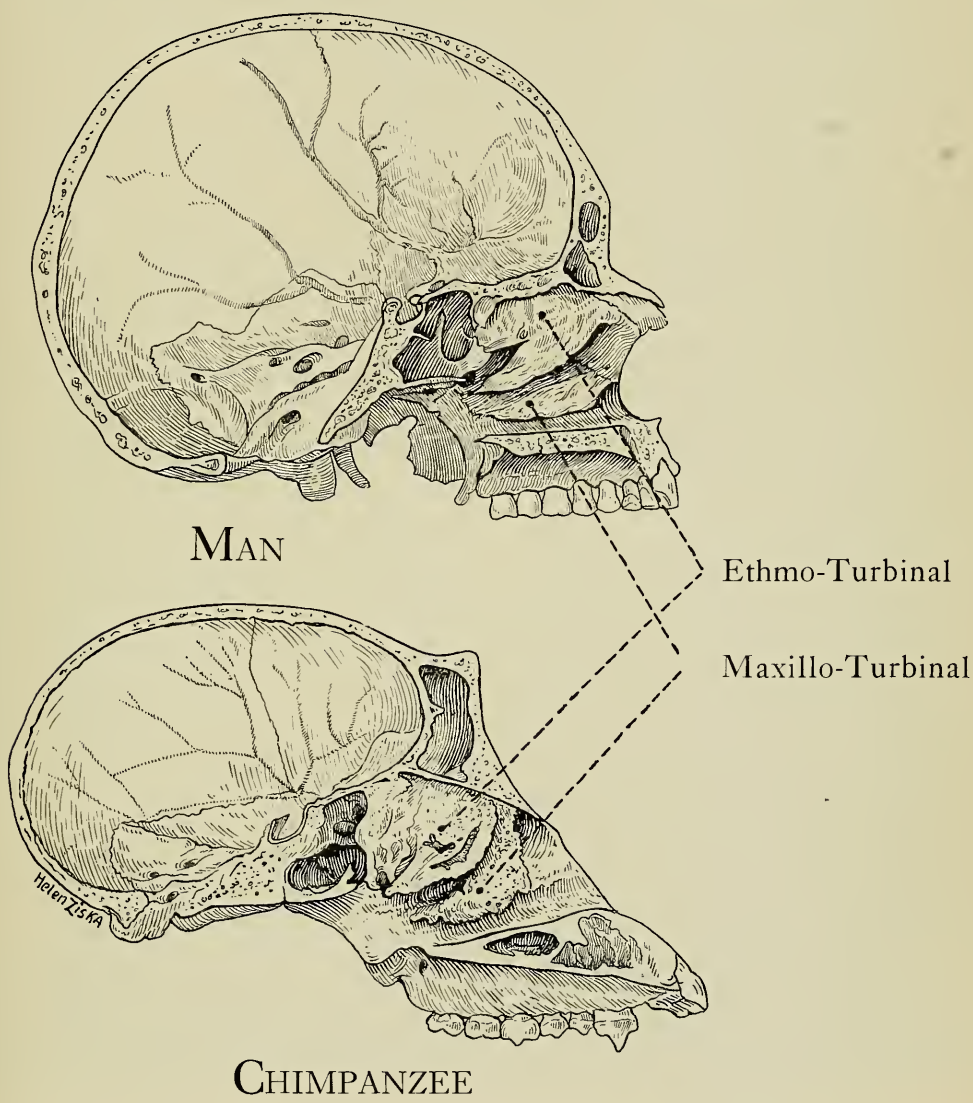


MAN'S AIR
CONDITIONING EQUIPMENT

The moist membranes of the turbinates, copiously supplied with blood vessels, cleanse the air of dust and warm it in cold weather

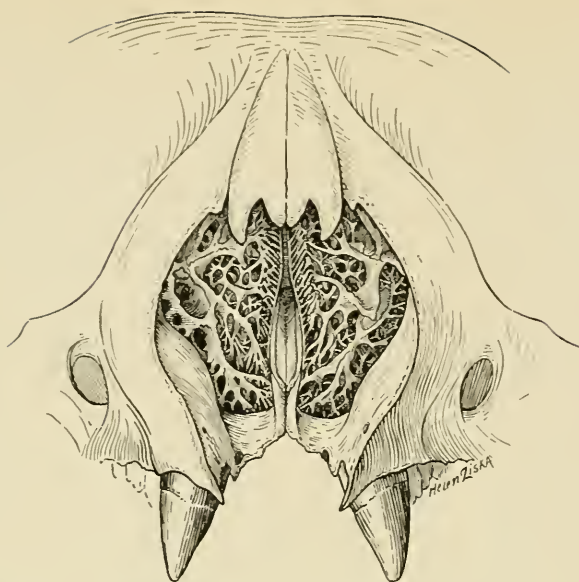
to a greater degree warmed or moistened by the hot blood that courses through them. Doubtless this lessens the shock of extreme cold air to the sensitive nerves of smell and prevents undue congestion of blood in the brain itself. In man as well as other animals the membranes are supported by delicate shell-

like bones called turbinate bones or turbinals, of which there are two groups. The membrane which is attached to the upper and inner turbinals (ethmo-turbinals) is the seat of the smell-detecting organs; whereas the lower and forward membrane is devoid of smelling organs.



The complexly folded membranes of the nasal chamber are supported by the delicate, shell-like turbinate bones. In the form and arrangement of these nasal "radiators," man most

closely resembles the gorilla and chimpanzee, whereas in some of the northern fur-bearing animals the turbinals are much further developed



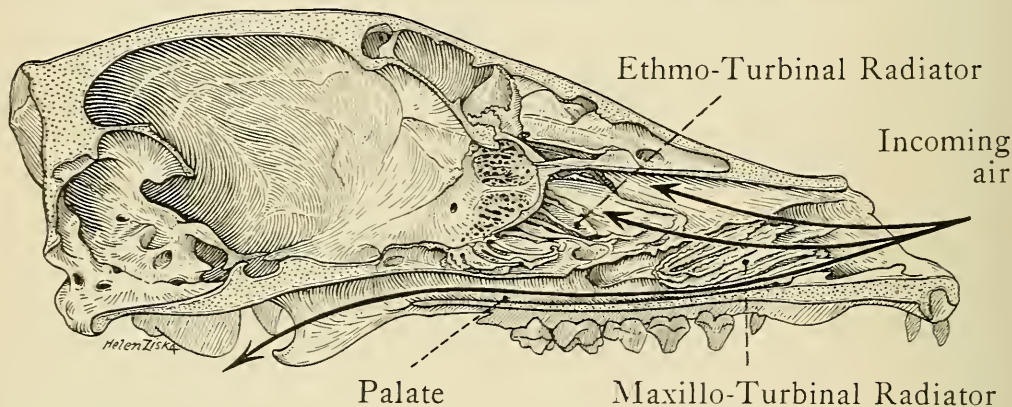
Especially in the seal does the air conditioning apparatus reach a high development, as is apparent from the accompanying drawing showing the complex network of the forward turbinals

The fact that the scrolls of the turbinals are much more complexly folded in most mammals than in man and present a greater surface to the incoming air is doubtless one of the causes of the superior smelling power of the lower animals. Man, as a rule, is far inferior to them in the delicacy of perception of smells.

Man most nearly approaches the chimpanzee and gorilla in the form and arrangement of the scrolls. These tropical animals possess a nasal air conditioning equipment that is much closer to man's than is that of the northern fur-bear-

ing animals. It is in the latter that the air conditioning apparatus reaches its peak. Especially in the seals are the forward turbinals (maxillo-turbinals) well developed, as can be seen by a comparison of the accompanying illustrations.

Doubtless man's poor equipment in nasal air conditioning apparatus is one of the reasons why either cold or very dry and hot air is so unpleasant in the human nasal chamber and why well-conditioned air is so welcome to us, both in summer and winter.



PERCEPTION OF SMELL

A reason for the superior smelling ability of many mammals is seen in their complexly folded ethmo-turbinals, which are the seat of

the smell-detecting organs. The drawing above shows how these turbinals are well developed in the keen-scented coati, a racoon-like animal

Fleischmann-Clark, American Museum, Indo-China Expedition

An Expedition into the remote and little known countries of Indo-China and Annam to secure some of the interesting and comparatively rare zoölogical specimens

PHOTOGRAPHS BY
JAMES LIPPITT CLARK

SAIGON. The Expedition members found this city of far-eastern Indo-China a miniature Paris even to its flower markets. Broad boulevards, lined with modern buildings and rows of shade-trees, and narrower streets with attractive French shops and side-walk cafes, dispelled thoughts of the jungle just beyond. Strictly modern docks and warehouses handled efficiently great shipments of rice, rubber, lumber and other products of the country



SORTING AND PACKING EXPEDITION EQUIPMENT. *From civilization the Expedition struck north into the back country where they established their field camps and did their collecting*



TRAVELING as far as they could go by auto they transferred all equipment to the bullock carts of the Mois and bumped along over native by-ways through jungles to the game fields

BASE CAMP was established in a tropical setting on the banks of the Lagna River. Here tigers roamed the jungle and fresh tracks were seen daily sometimes within a hundred yards of the camp



ALTHOUGH ROAMING HERDS of elephants often passed by their encampment and serenaded them as they supped in their open air dining room they dined well with French cooking prepared over a fire built in a hole dug in the ground

LOCAL NATIVES, THE MOIS, *the aborigines of the French Indo-China country were recruited as guides and porters. They lived on the river bank by the camp under the shelter of simple structures of bamboo and palm leaves*

Life in a Moi Village

WOMEN AND CHILDREN OF THE MOI. *Like most native tribes the women and children tend the garden, gather the crops and grind the rice while the young boys herd the stock. The men hunt and fish or lumber the big trees and sell hewn logs to the white men*



NATIVE VILLAGES OF THE MOIS *were scattered through the surrounding country. Within such a compound several community houses are built on high stilts as protection against tigers, snakes and floods*

MOI MEN IN THEIR VILLAGE COMPOUND. *The Moïs are of Malay extraction. They are primarily rice eaters, clearing forest areas and tilling the soil for rice paddies. As there is no irrigation they depend wholly upon the rains*



MOI PORTERS PREPARING SPECIMENS TAKEN BY THE EXPEDITION. *Complete specimens of the Asiatic water buffalo, the Saladang or Guar-ox and the wild-ox called the Banting were secured as well as many lesser animals. Birds, reptiles, fish and other interesting specimens, also swelled their collection*



DR. CLARK AND A FULL GROWN MOUSE DEER collected by him while night hunting. *This, the smallest of all deer, stood only eight inches at the shoulders and weighed but four pounds. When skinned it was found to contain a full grown embryo which was preserved and added to the collection of valuable specimens*



(Lower left) AN ANNAMITE VILLAGE STREET. *The Annamites, the "civilized" people of Annam, are of Mongolian extraction and build adobe houses of quite pretentious design and detail. They too live principally on rice; but do not intermarry with the Moi*

(Lower right) MAJ. MAX C. FLEISCHMANN, INTERNATIONAL SPORTSMAN AND BIG-GAME HUNTER *sponsored the expedition and through his tireless efforts in the field secured many of the expedition's most valuable specimens*



The Conquest of the Air

Nature's achievements in the air compared with man's: the story of flight from prehistoric times to the present

By WILLY LEY

Drawings by George F. Mason

ONE sometimes reads that the conquest of the air was first made in 1783, when the Montgolfier brothers in France filled for the first time a big bag of paper with heated air. Needless to say this is the statement of the engineer, not of the natural historian.

As a matter of fact, it could be argued that the Montgolfiers were certainly not the first men to attempt to fly, and it is even doubtful whether they were the first to succeed. Then, it has to be stated that the assumption of the engineers that there are only men and machines on earth, is wrong. The flying animals and also plants existed for hundreds of millions of years before the appearance of man.

Lessons from Nature

The real assertion we must make about human aviation was expressed as early as about a thousand years ago with the short sentence "*Natura Artis Magistra*," Nature is the master (teacher) of the arts. If there were no flying animals man might never have thought of flying.

Natura Artis Magistra must not be misunderstood. Man does not follow Nature exactly. Any attempt to copy exactly is bound to fail for the perfectly logical reason that we do not construct on the same scale and with the same materials used by Nature. There are inventions that work satisfactorily when demonstrated with small models, but when built on large scale in exactly the same proportions, they fail to work, because the ratio between stresses and strength changes with the size. A dragon-fly seems a perfect airplane, but if it

had the dimensions of a real airplane it would break to pieces if it only tried to beat its wings. There was a short period in the development of the railway, when engineers tried to imitate the legs of a horse on the locomotive. These experiments, which seem ridiculous to our knowledge, had soon to be abandoned. Their inventors had not learned from Nature but had tried to imitate Nature exactly, just as did some of the first inventors of airplanes when they tried to make them beat their wings.

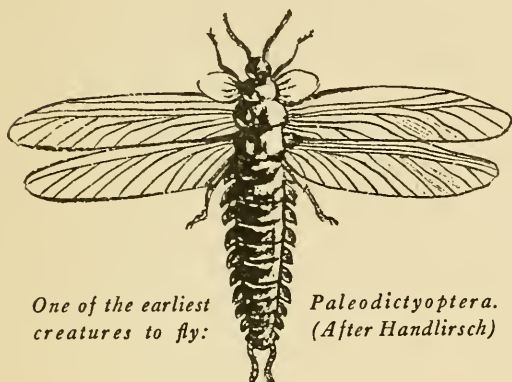
Principles

There are widely differing ways in which flying is achieved, both in Nature and in human aviation. A zeppelin flies and a China clipper flies, but the principles are not the same. Likewise the flight of the swallow and of a flying squirrel differ in principle.

Basically there are two main types of flight, (1) the flight of "heavier-than-air" bodies (also called dynamic flight or real flight); and (2) the flight of "lighter-than-air" bodies (static flight or floating flight). Balloons, stratosphere balloons, sounding balloons and airships operate under the second principle, owing to the fact that they have a huge bag filled with a gas that is lighter than air. If the craft has propellers they are used mainly for horizontal movement.

The airship type of flying does not occur in the animal kingdom. But plants have taken advantage of the fact that heated air is lighter than cold air and tends to rise. There is a pine tree in Europe, the German *Kiefer*, which grows in great abundance in Northern Germany, especially in the province of Brandenburg around Berlin. On calm, warm days one can observe big yellow clouds, hovering just

above the tree-tops of the forests. These clouds are dust clouds, composed of myriads of tiny particles of pollen. Every one of these pollen particles has two microscopic bags of skin at-



One of the earliest
creatures to fly:

Paleodictyoptera.
(After Handlirsch)

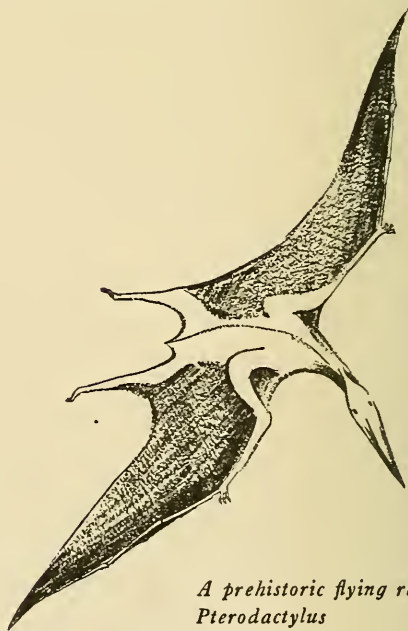
tached to it, filled with a small quantity of air. When the sun's rays strike the pollen (in the open male flowers of the tree) the air in the little skin bags is heated, it expands and, being warmer and lighter than the surrounding air carries the pollen upward. If there is no wind to blow them away they float above the forest all through the day until sunset comes. Then the lifting power of the air bags diminishes and the pollen begin to float gently downward. Billions and billions miss their destination and die, but a few of them fall on the open female flowers of the trees and grow into seeds. The latter, incidentally, are later capable of another kind of flight, having adopted the twirling autogiro principle used by the seeds of elm and maple trees.

The other method of flying, that of heavier-than-air bodies, includes three methods, namely, gliding, soaring, and true flying. A fourth method has been added recently by man, the reaction principle, which makes powder-filled sky rockets as well as scientifically designed liquid fuel rockets shoot up into the sky. But here again, *Natura Artis Magistra*; there is nothing really new under the sun. The squid and all other Cephalopoda, along with most jelly-fish (*Medusa* and *Siphonophora*) swim by this same principle, though it has not been utilized in the air by any animal.

Actual flight differs from soaring and gliding mainly in one respect: it requires power, muscular power or engine power, as the case may be. Gliding (powerless) flight in still air

can never attain altitudes above the point of departure; powered flight can. Powered flight produces artificially, either with beating wings or by means of a propeller, a stream of air which enables the body to move not only horizontally but also up and down. Whether the machine is an ordinary airplane, an autogiro or a helicopter does not matter, all are in this respect applications of the same principle.

While we know exactly when and where powered free flight with a heavier-than-air plane was successfully made for the first time—it was the flight of the Wright Brothers' "strange contraption" at Kitty Hawk—it is somewhat obscure and doubtful when Nature succeeded for the first time in the same task. We can only judge from the fossils we have found, and these tell us that the first real flyers on earth were certain insects of the Carboniferous Period. Among these were what may best be described as gigantic dragon flies, which attained a wing-spread of about seventy centimeters, almost thirty inches! Actually they are only distantly related to our present-day dragon flies and had many radically different features. Then too there were the curious *Paleodictyoptera* which had evolved three pairs



*A prehistoric flying reptile:
Pterodactylus*

of wings. All insects have three pairs of legs when adult or else have lost them through degeneration. They never had more. But the wings apparently did not follow the rule of

three pairs. Only the Paleodictyoptera had "full wing equipment," butterflies and dragon flies have two pairs of wings, other insects show only one pair or none, and a few like the common fly prove that there was once a second pair which has degenerated. No insects, either living or fossil, were ever known to possess a trace of a third pair of wings until these Carboniferous fossils came to light. They show the original third pair very distinctly; but they also show that it was already degenerate in those times.

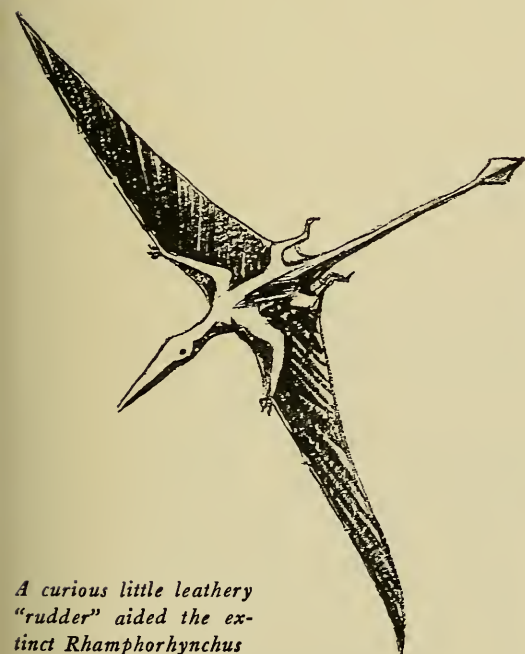
The other branch of true flyers of today are the birds, whose ancestors were presumably the flying reptiles of the Jurassic Period. The feathers of birds are nothing but the modified scales of their reptilian forebears, their wings the changed fore-limbs of tree-climbing animals. When certain prehistoric lizards developed wing-like membranes they became what we call Pterosauria or flying lizards.

We know the fossil remains of many dozens of different types and varieties of pterosaurians, ranging in size from a sparrow to an eagle. One kind are called the Pterodactyli ("winged-fingered creatures") from the fact that the wing-membrane extends from the tip of a greatly elongated fourth digit, along the back of the arm and the side of the body. Its mode of life was probably very much the same as

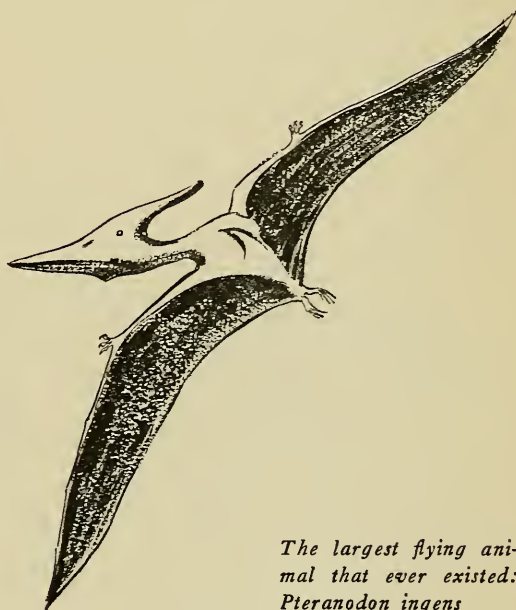
that of the bats of today; the large eyes of many ancient varieties even indicate that they flew chiefly in the dark or at least in twilight. The severed species of the genus known as the Rhamphorhynchus are more slender and are equipped with a long tail at the end of which is a curious little leathery "rudder." Many scientists call this type a "reptilian sea gull" and believe that it lived mainly near the sea-shore and fed on fishes.

While the Pterodactyli and the Rhamphorhynchi were primarily European types and belonged for the greater part to the Jurassic Period, America had produced the remains of the largest flying animal that ever existed. This was *Pteranodon ingens* (the "giant toothless flyer"), which has been found in the United States in the so-called Niobrara layers of the Cretaceous Period. *Pteranodon's* wingspread was enormous, up to an estimated 21 feet. At the time when it existed parts of the present-day United States were covered by a sea, known as the American Niobrara Sea, and it was over these waters that *Pteranodon* flew in search of fish for food. *Pteranodon* was a short-tailed type, but it nevertheless had its "rudder" attached curiously enough to its head in the form of a long bony keel-like ridge on the back of the skull.

The third group of active flyers, the bats, appeared on earth much later than the birds.



A curious little leathery "rudder" aided the extinct *Rhamphorhynchus*



The largest flying animal that ever existed: *Pteranodon ingens*



Fruit-eating bat

They evolved during the Tertiary Period, when the pterosaurians were already extinct. These three groups of animals, pterosaurians, birds and bats represent three different ways in which the fore-limbs have developed to form wings. While two of the original five fingers of the birds grew together and provide only the "leading edge" for the stiff feathers that form the wing, in the case of the bat four of the fingers grew out of all proportion, so that they form the skeletal structure of the membranous wing. The pterosaurians also used skin as the material of their wings. But this skin was spread from only one finger, the fourth finger, which grew as long as the arms and the body of the animal together.

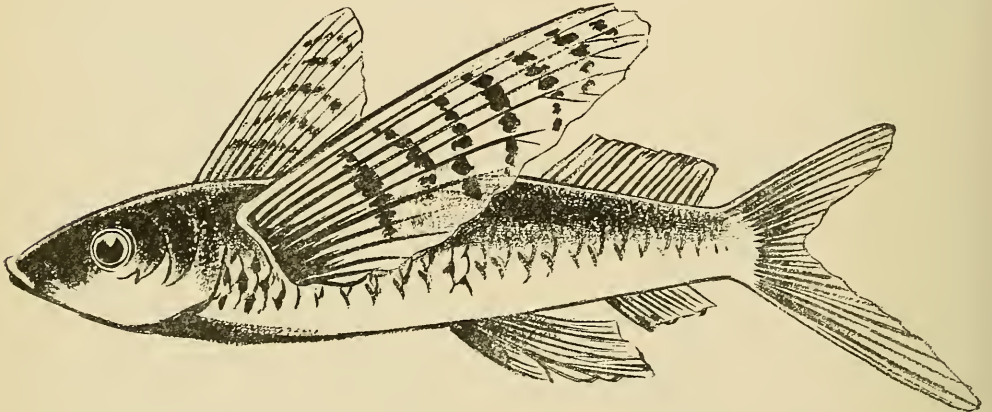
Why we have not been able to construct airplanes that beat their wings is easy to explain; they are much too large for this principle of operation. For other reasons no flying

animal ever developed a propeller. We have the negative analogy that Nature never developed the wheel. Among Nature's building materials are blood vessels and nerves. These materials are unsuited for a wheel-like organ because they would be twisted around each other and torn off at the connecting point. This obstacle is circumvented in mechanical construction, but with the living tissue as material it appears to be impossible.

With the exception of a little crab all gliders are vertebrate ("backboned") animals and there are representatives of them in all classes. Among the fishes we have the flying (more properly called gliding) fish, which are abundant in all tropical and semi-tropical seas and known to everybody who ever lived in or visited the tropics.

Though there are at least fifty varieties of "flying fish" known and though they can be observed in large numbers on almost any day of the year it has been a matter of lively controversy for many years whether the "flying fish" are flyers or gliders. This controversy is definitely settled now, the flying fishes do *not* fly. Their fins seem to move sometimes, but this is only a quivering motion. The "flight" of fishes is a prolonged jump out of the water which turns into a glide. The large pectoral fins which serve as wings do not beat the air as has been believed.

The fish propels itself under water and jumps out of it with high speed at an angle



Flying fish

which approximates thirty degrees. Once the water is left the large pectoral fins are spread and carry the fish over a considerable distance, "flights" of 600 feet having been reported. That the prolonged jump is no actual flight is evident alone from the fact that flying fishes are never seen in the air on still days. They need wind to fly.

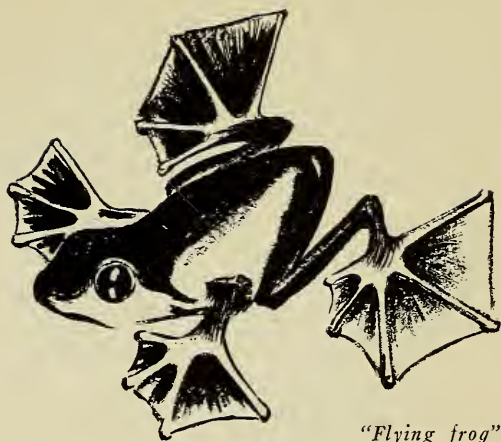
Some observers have reported that their flight shows an undulating motion corresponding to the waves of the sea. This is only natural, for the air currents conform to the curvature of the waves. Indeed, an up-draft will sometimes send a flying fish to the deck of a vessel, where a local calm area causes the creature to drop helpless.

The next class of the vertebrate animals, the amphibians, apparently never made a really successful attempt to conquer the air. Of all amphibians only one makes a feeble effort to rule the air, the "flying frog" (*Polypedates reinhardtii*) of Java. It is a good-sized frog that lives in the tops of the trees and actually flies to a small extent by using its enormous webbed feet in a sort of gliding fall. It is conceivable that sometime in the remote future *Polypedates* may improve its aerial tactics beyond this simple maneuver and win a more worthy place among the creatures that have undertaken to master the realm of the air.

In the same tree with *Polypedates* lives the only flying reptile of today, the "flying dragon" (*Draco volans*). In spite of its formidable name it is only a small and delicately built tree-lizard, about four inches long. Its "parachute" is of a type that bears no resemblance to that of any other animal. From either side of the body a number of ribs extend to form the skeleton for the parachute, the shape of which differs with the variety. Some have triangular parachutes, others semicircular ones.

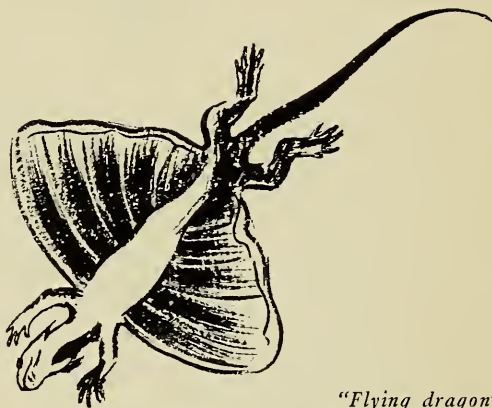
It is not quite true that the flying dragon is the only reptile of our times that attempts to glide through the air. A snake in the East Indies, *Chrysopelea ornata*, has learned a similar trick. It also lives on trees and while gliding over twigs and branches the snake is able to flatten its body to such an extent that it begins to resemble a folded sheet of paper. In this position, stiffening the body like a stick, the snake can glide through the space between two trees over considerable distances and with high speed.

There remain only two other classes of



"Flying frog"

vertebrate animals, the birds and the mammals. The study of the flight of birds is complicated, and can scarcely be gone into in a general dis-



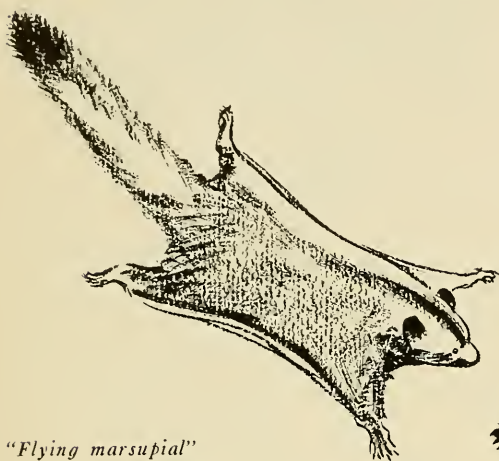
"Flying dragon"

cussion; and the peculiar wings of bats have already been mentioned. But there are a few mammals besides the bat which have achieved



"Flying squirrel"

a certain degree of aerial ability. They possess a skin stretched out on either side of the body between fore and hind legs, and the long tail acts as a rudder in flight. The flying squirrel belongs in this class. Then there are gliding marsupials, which have developed the same



"Flying marsupial"



"Flying lemur"

method. And finally there is the "flying lemur," *Galeopithecus*, which looks like a very large flying squirrel. It is not a squirrel, however, and has been classed in a separate order including only one family and two varieties.

Galeopithecus leads a life that resembles that of certain tropical fruit-eating bats. During the day it sleeps in the trees, wrapped in its parachute and hanging by all four limbs, like a sloth. When darkness arrives it starts out on its nightly expeditions. It is to be noted that *Galeopithecus* is the best glider of them all, and special muscles in the skin of the parachute seem to indicate that the flight is not absolutely passive.

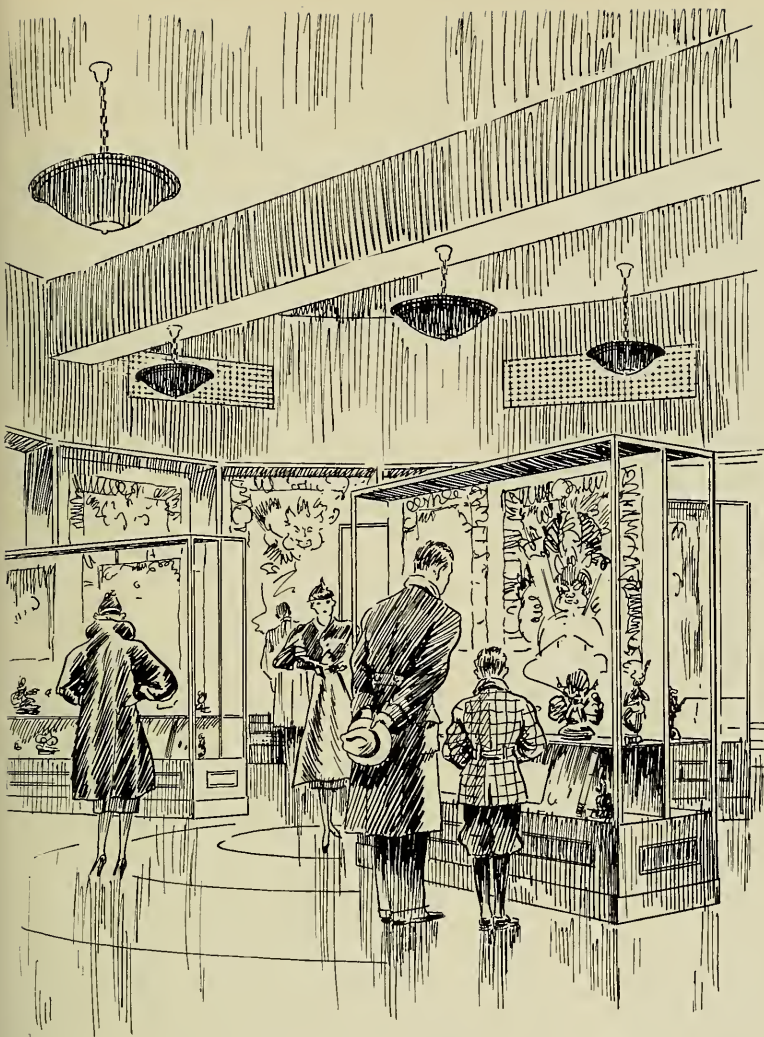
To this long list of active and passive flyers we have to add young spiders of several varieties. They take long air rides on threads spun especially for this purpose. The thread is almost without weight yet it offers sufficient surface in an ascending breeze to carry the rider upwards and enable it to drift. Small spiders wafted along in this manner have been ob-

served on the high seas (Darwin related one case), and it is certainly not by accident that the varieties of spiders that make these flying webs have an especially wide distribution. It has also been observed that small caterpillars make flights of the same kind, either on threads spun by themselves or simply with the long furry hair that covers their bodies. Whether the caterpillars make these flights otherwise than by accident, is still disputed.

The conquest of the air began about five hundred million years ago or more, when the possibly Devonian ancestors of the Paleodictyoptera started flying. And the conquest has

continued all through the geological ages and is still going on. Man has observed the methods used by the animals, and has imitated them. He has modified the methods, but the flying animal and the flying machine obey the same natural laws. He has succeeded in rising into the air far higher than the birds; and one hesitates to set an ultimate limit on his aerial activities. In horizontal distance the non-stop cruising range of modern airplanes is already greater than that of such hardy migrants as the golden plover, which flies from Bering Sea to Hawaii. But lest we imagine that man has duplicated mechanically all the aerial feats of Nature, let it be pointed out that even the fastest airplanes are possibly not as yet able to surpass the reported speed of certain insects.

NATURAL HISTORY has the honor to announce the publication in a future issue of an article by Amelia Earhart on the subject of Speed. The article will be an interpretive study of the fastest speeds attained in Nature in comparison with the mechanical achievements of Man



*William B. Whitney
Tibetan-Lamaist
Collection*

Drawn by Frank Swain

William B. Whitney Tibetan-Lamaist Collection

THE Tibetan-Lamaist Collection which has been gathered together during the last 12 years by William B. Whitney of New York City and is soon to be installed in the American Museum of Natural History is believed to cover the iconography of Lamaism more comprehensively than any other collection on public exhibition in this country, or, so far as is known, in Europe.

The collection comprises nearly 60 painted banners, or *t'ang-k'as*, approximately 400 images, a large number of clay bas-reliefs, and numerous ritual objects and other articles closely associated with Lamaism, altogether

more than 800 items. The various articles have been carefully selected by Mr. Whitney, the banners and images especially with reference to their religious symbolism. In addition to the articles exhibited Mr. Whitney plans to give the Museum, whenever a suitable room can be provided for reference and study, the more than 100 banners and other objects completing the collection and a small library of books dealing especially with the subject.

The cataloging and installation have been carried out according to Mr. Whitney's directions by Antoinette K. Gordon, and the Hall will be opened to the public December 15th.

The known history of religion and art in Tibet begins with the introduction of



(Left) THE ONLY FEMININE DIVINITY among the "eight terrible ones": Śrī-devī (The Glorious Goddess), a Defender of the Faith of Buddhism

(Below) WHITE SAVIORESS: here shown in one of her manifestations called "Uṣ-nīṣasītātatapatrāparājītā," in which she has innumerable eyes all over her body, symbolizing her omnipresence. She is often called "The Mother of all the Buddhas"

Buddhism in the 7th century. Previous to that time the religion of Tibet was a form of nature worship, Pön demonology, carried on by primitive wizard-priests and involving human sacrifices. The Buddhist religion was introduced by the Chinese princess, Wen-ch'eng and the Napalese princess Bhṛkūtī, both wives of the Tibetan king, Sron Tsan Gampo. In the 8th century succeeding kings sent to India for teachers, among whom Padmasambhava from Nalanda University adapted the primitive deities and rites of Tibet to Buddhism and thus conciliated the Pön priests.

In the 17th century the Fifth Grand Lama of the Established Church, who became the first Dalai Lama, developed the idea of the succession by reincarnation and divine reflexes, which still exists.

Some of the deities represented in the Whitney Collection come from India, specifically the Sivaite deities; others from the indigenous Pön religion of Tibet.



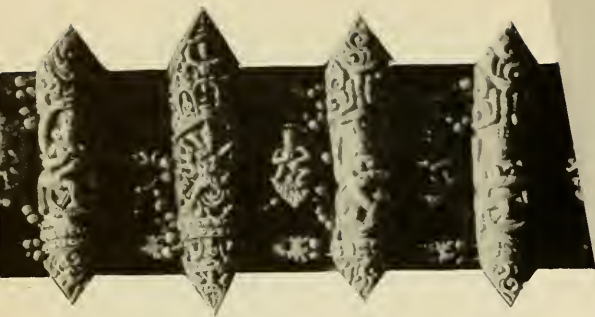
(Right) HOROSCOPE: one of several methods of divination. The diagram in the center of this amulet box containing prayers is a "magic square," each column of which adds up to 15



(Below) SITA SAMVARA, Tutelary Deity with his consort. Every Lama is under protection of a special tutelary. This deity is believed to be incarnate in the Grand Lama of Pekin

(Lower right) TO WORSHIP HER brings good luck and destroys all obstacles: Ekajaṭā, a form of the Blue Tara



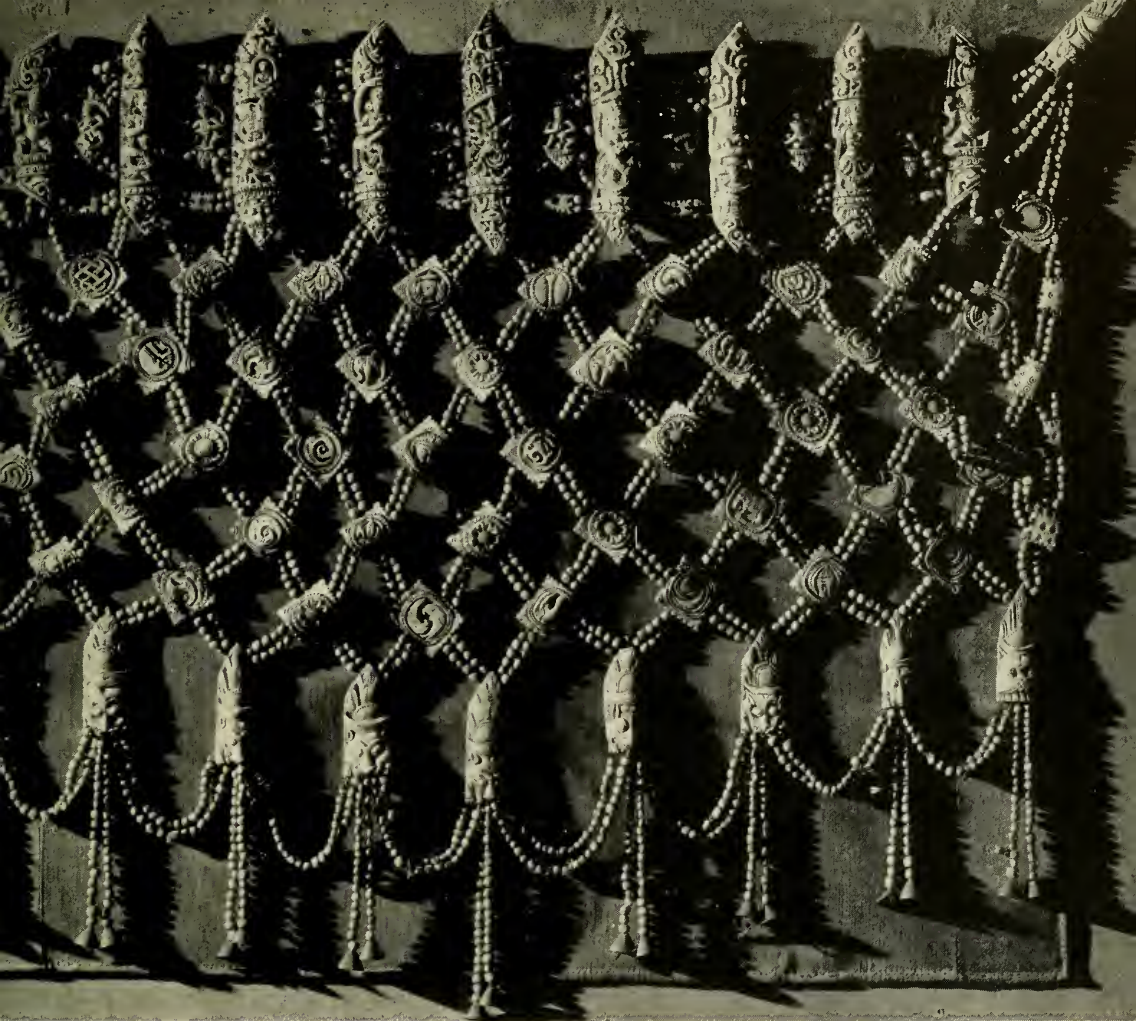


(Right) THE PRIMORDIAL BUDDHA or Adibuddha of the Yellow Cap Sect: Vajradhara, the supreme power and creator of all things



(Below) NARO WHO LIVES IN THE HEAVENS: Naro kha chö-ma, a dākinī or fairy, who is invoked for the granting of supernatural powers



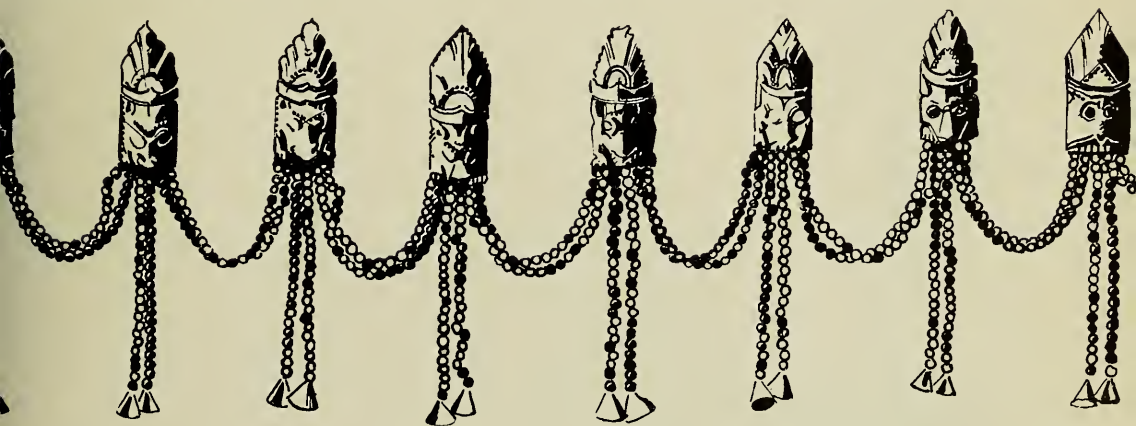


(Left) A DEMON KING of the old Pönist religion: Dor-je lek-pa, who was subjugated by Padmasambhava, the founder of Lamaism

(Left) MOST POPULAR DIVINITY in the northern Buddhist Pantheon. Avalokitésvara, a form of the God of Mercy and Compassion

(Above) HUMAN-BONE APRON: These aprons and other ornaments of human bones are used by the Black-Hat Lamas and sorcerers in their necromantic rites. Usually made from the bones of criminals, they are considered of especially sacred character

(Below) DETAIL of intricately carved pendants of human-bone apron





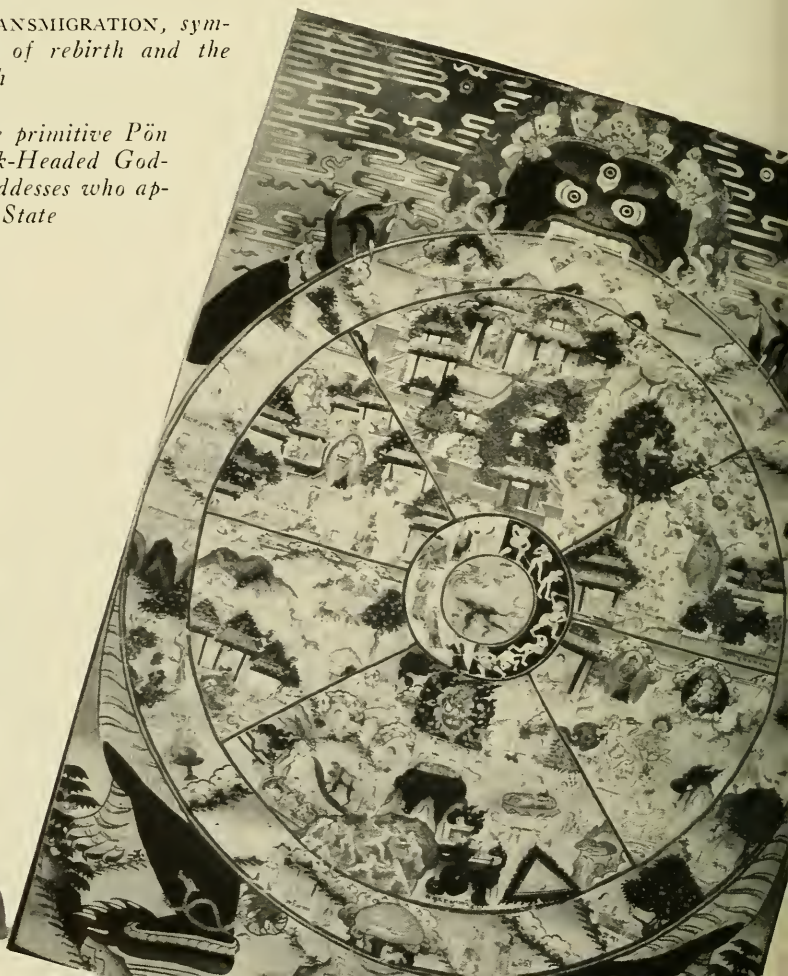
(Above) FOUNDER OF YELLOW CAP SECT, Established Church of Tibet: Tsong-kha-pa (1357 A. D.-1419 A. D.), a great reformer and teacher



(Above) THE ONLY HISTORICAL BUDDHA (within our knowledge): Śākyamuni, founder of Buddhism, who preached his doctrine until about 543 B. C. Disciples incorporated his teachings thereafter

(Right) WHEEL OF TRANSMIGRATION, symbolic of the six regions of rebirth and the twelve reasons for rebirth

(Below) A RELIC of the primitive Pön religion: the Brown Yak-Headed Goddess one of the Bardo goddesses who appear in the After Death State



The Story of Domestic Animals in America

Nearly all the animals vital to the growth of this continent, from the sheep to Jefferson Davis's camel corps, were importations

By GEORGE G. GOODWIN

*Assistant Curator of Mammals,
American Museum*

IT is no secret that such "zoo" animals as the lion and the tiger are not native to North America and probably never were. That is common knowledge.

What few of us realize is, that nearly all of our "native" domestic animals are not natives of this continent at all, but are among the many things imported into the country by our far-sighted forebears who saw a need for them in the expanding commonwealth.

These animal importations have played so great a role in the building of the United States, that they have grown up as part and parcel of the country. They are "taken for granted." Yet, we repeat, they are importations, and we will herein attempt to tell the tale of how they were brought to these shores.

Native animals

It is unfortunate that the first Europeans to reach America were the rather incurious Spanish, thirsty for gold, who made few intelligent observations of living methods among the American Indians. But this we know, that the Indians had only three domestic animals of any importance: the dog, the turkey, and the llama. The great prairies of the American interior teemed with herds of buffalo, elk, antelope; and the forests and mountains supported great numbers of mountain sheep, goat, and moose. Countless numbers of caribou and herds of musk oxen thrived in the vast barren lands of the Arctic. Yet, in spite of this lavish abundance there was not in all North America, from the Arctic to Panama, one single race of animals that was suitable for domestication.

The red men traveled on foot or by canoe.

Nomadic, wandering tribes though they were, they possessed no beasts of burden, no horses or domesticated cattle, and they made no attempt to harness the tremendous power of the buffalo. There is no indication that they even went so far as to take milk from any of the native animals. True, the American Indians did have a dog, the history of which is rather obscure, which was sometimes made to drag the travois, a primitive wheelless luggage frame, and in the sparsely inhabited Arctic the sledge dog was a necessity. But the chief service of the dog to the red man was as a companion or pet, not as an economic asset.

It must not be supposed that it was through lack of intelligence or ability on the part of the red man that he failed to utilize the native animals as beasts of burden. After the introduction of horses it was not long before the Indians were hunting and fighting on horseback. A conspicuous feature in the reminiscences of the early settlers is usually the hostile Indian braves on their piebald ponies. In fact, it is hard to picture the Indians without their horses.

First cattle

No trace of a native race of cattle of any type has been found in North America. Columbus, on his second voyage, apparently brought the first cattle to America in 1493. The first reliable record on the introduction of cattle into the mainland of America is in a report found in the Spanish Archives at Madrid. It states that Gregorio Villalobos, in 1521, brought a number of calves from Santo Domingo to Mexico, landing them near the town of Vera Cruz. These were descendants of the cattle brought from Spain to the West Indies in the years immediately following the voyage of Columbus.

The Texas long horn, once so spectacular in the Southern states and Mexico, originated from a type found in Spain in the 16th century. They were rather small, of a light brown or dark jersey color, neither good beef animals nor suitable for dairy products. Their hardiness and ability to thrive under barren conditions were their chief recommendations.

When stabilization of the United States Government several decades later encouraged the importation of long horn breeding stock into Texas, it did not improve the status of the long horn. After 1860 the Hereford rapidly and completely displaced the Texas long horn on our Western ranges. Today the Texas stock has undergone considerable change owing, curiously enough, to the infusion of a breed from India.

Zebu blood

The humped cattle of India, known as the Zebu, domesticated in Asia about 4000 B. C., was introduced in South Carolina in 1849 on account of its ability to resist disease, parasites, heat and drought. A few years later it reached South Texas, where it proved its value for crossing with the cattle of western Europe breeding. Now much of the Texas stock contains Zebu blood. They are commonly called Brahmans.

Hogs were brought into the new continent as early as 1525 by the Portuguese who in that year landed some on Cape Breton Island. From here they soon spread to Newfoundland and the mainland. They appeared to have thrived, for 13 years later, Mendoza, in reporting to his sovereign, referred to the favorable condition of his cattle, horses, and merino sheep, which he had imported from Spain. The sheep, he said, had been prolific.

The story of the horse in America is one of the most stirring. The Spanish conqueror Cortez who in 1519 brought the first horses that ever set foot in the New World had only 16 of the animals when he landed at the mouth of the Rio Panuco, and he probably never had as many as 100 during the conquest. Yet the appearance of man mounted on four footed animals struck the Indians with such dread and the handful of cavalry were so effective against the Indian foot soldiers, that the horse was one of the foremost factors in the conquest of the greatest Indian nations.

The great Spanish expeditions that explored

the southern parts of the United States were well equipped with horses. While the date of the origin of horse culture among the Indians is speculative, its limits, according to Dr. Clark Wissler, are clearly defined. The horse cannot have reached the Indians before the 16th century and we find it in the Far North in 1751.

Wild horses

In 1541 De Soto carried some of his horses across the Mississippi, and it is generally assumed that the horses abandoned by his men in that year were the nucleus of the wild horses later found west of the lower Mississippi. About the same time Coronado reached the present bounds of Oklahoma from Sante Fe, and Ornate is believed to have visited the Pawnee and Kansas in 1599 to 1601. From Coronado's time on there was a growing trade with the Indians of the Gulf Coast; and, beginning about 1600, trade with the interior with Sante Fe as a base. The Indians of the plains, especially the Pawnee, were so troublesome in their plundering raids for horses that a post was established in Kansas about 1704. It is clear, says Wissler, that the Indians below the Platte and lower Missouri were well supplied with horses by 1682, and there is no reason why many of them should not have had horses as early as 1600.

If the dates for the first mention of horses are tabulated, we have a progressive series northward, beginning with 1682 below the Platte and culminating on the Saskatchewan in 1751. In every case, however, we can assume an earlier date for their introduction.

From the very first the Spaniards were great importers of horses and other domestic animals. In this respect they stand in contrast to the French of Canada, where the first horse was imported in 1647.

The English colonists imported horses early but moderately, except among the cavalier element in Virginia. The first horses imported by the New England colonies came in 1629. Horses spread among the Indians of the Atlantic slope, but it was only in the south that they were numerous.

It seems clear, therefore, that the Spaniards must be credited with the introduction of the horse to the Indians of the plains and the lower Mississippi, both east and west; the greater number of horses must have come from

their settlements in the southwest and Mexico.

One of the most extraordinary stories in connection with the introduction of domestic animals into the United States is that of the camel. So far as most citizens are concerned the American habitat of the camel is the zoölogical park. Few realize that this odd looking creature came close to establishing himself as an accredited member of the American animal kingdom.

For desert warfare

A formidable danger to small frontier garrisons and settlements in the southwest was the hostile Indians of the region. Their sudden attacks could not be repulsed by the foot soldiers and cavalry, and their fast ponies easily escaped into the desert where it was impossible to follow them. Furthermore it was impossible to transport army supplies through the rough and arid country with horses and pack mules. Thus, reasoning no doubt that in a desert country the ways of the desert tribes of Asia with their swift moving camels could be adopted, Congress in 1855 appropriated \$30,000 to enable Jefferson Davis with Major Henry Constantine Wayne and Lieutenant Davis D. Porter of the Navy as leaders to go to Asia for the purpose of securing camels. Wayne went to England and then France seeking information on the treatment of these animals. He consulted French officers who had used the camel in Algeria, and the details derived from them led him to believe that the Asiatic camels would be more suitable in the American climate than the African camels.

Porter, in command of the store ship *Supply*, proceeded to the Mediterranean to meet Wayne at Spezzia. En route he inspected the camels belonging to the Duke of Tuscany at Pisa, a herd descended from Egyptian stock which had been used in Italy for 200 years. But he concluded that these animals were not suitable for his purpose. Accompanied by Wayne he went on to Tunis, where Mohammed Bey gave them two camels. These they kept on board to study the habits, ailments, and care of the animals.

The next stop was at Smyrna, where they found some fine burden camels, but no dromedaries of the type Davis needed for chasing the Indians.

At Salonica, no camels were to be seen; all had been commandeered for use in the Crimean

War, then raging. Wayne and Porter pressed on to Constantinople, and thence to the Crimea, to see what use was being made of the camels in the war. At Constantinople Wayne was disappointed. All the camels available were worthless. The Sultan sent far into the interior for good ones to give them, but Wayne, anxious to go to Egypt, did not wait for them to be brought to Constantinople.

The *Supply* then sailed for Alexandria. Wayne arrived at Cairo in search of a permit to export dromedaries. Permission was, at first, only granted for two, but it was later extended to five. The Viceroy notified him that he would make a present of six camels to the United States, but Porter, on examining the animals offered, found them diseased and refused the gift. The Viceroy laid the blame on his servants and six good dromedaries were substituted. These, with three others, were all that were shipped here. They then returned to Smyrna to complete the cargo.

On February 15th the *Supply* set her course for America, carrying a cargo of 33 camels: 9 dromedaries from Egypt, 20 Arabian burden camels, one young Arabian camel, two Bactrian, one Booghdee or Tuilu. (Wayne defined the Bactrian as the two-humped animal, the Arabian as the one-humped and the "dromedary" was merely a swift Arabian, not a burden animal, the Booghdee or Tuilu as cross bred.)

The health of the camels

Two Turks, one a doctor, and three Arabs were brought along to look after the animals. Some of the Turk doctor's prescriptions were recorded by Porter as follows: for a cold give the camel a piece of cheese; for swollen legs, tea and gunpowder; for skin diseases, cauterize with a redhot iron. One extraordinary remedy for some ailments was to boil a young sheep in molasses and to administer half the boiling mixture down the unfortunate creature's throat; and for other complaints, tickle the camel's nose with a chameleon's tail. The return trip lasted three months. During rough weather each animal had to be strapped to the deck to prevent it from falling and injuring itself.

On April 29, 1856, the *Supply* reached Paso Cavallo, off Indianola, but the sea was too rough to make a landing, and Porter then sailed to Belize and there on May 10th trans-

ferred the animals to the Steamer *Fashion* under Major Wayne. Four days later they were landed at Powder Point, three miles below Indianola.

On November 14th, the *Supply* again set sail for Texas with forty-four animals—two Bactrian males; three Arabian males; two Tuilu, cross breds; and thirty-seven Arabian females.

At the end of 1856, Davis reported that in his opinion the experiment was a success. Secretary Floyd, who succeeded Davis, was convinced of the usefulness of camels on the western plains, and in December, 1858, he recommended that 1000 be purchased.

The success of the War Department induced others to import camels. In 1858 a British vessel brought two cargoes of camels for Mrs. Watson of Houston, Texas. In 1861 a San Francisco Company imported 20 Bactrian camels for use in transporting salt in Nevada.

It was in 1861, according to W. M. Davis, Secretary of the Nevada Highway Association, that camel transportation was put into practice in Nevada. The camels were a portion of a herd of Bactrian camels imported to carry supplies to army posts in the arid regions.

Look on an old map of the State of Nevada and you will find a section to the south and east of Dayton marked as "Camel Flat." Other maps give the name as "Campbell Flat." The first-named is the proper description, as this is the place where the camels were herded. These camels were used in the transportation of salt across the desert from Churchill County, in the vicinity of San Springs, to the mining camps of Austin and Virginia City, where immense amounts of salt were used in the treatment of ores by the chlorination process. Some of the camels were used near Virginia City as late as 1876.

Camels prohibited at large

This method of transportation did not prove a success, and the animals were soon turned adrift, but not before the legislature of the State of Nevada had passed an act prohibiting camels from running at large upon the highways. This was in 1875. In July of that year a letter written by Colonel Philip Reade states that he saw a herd of wild camels near Oatman's Flat on the Gila River. A prospector reported in 1925 that he had seen one of these animals ten or fifteen years previously in a

wild portion of the state at about dusk, and had the scare of his life at the appearance of the unexpected beast.

When the United States forces left Texas in 1861, the camels fell into the hands of the Confederates, who made little use of them and spent little care upon them. They were turned loose to graze, and some wandered away. The stray camels were heard of occasionally, stampeding horses and ravaging fields, and some were killed and eaten by the Indians.

The last of the camels

Indeed, the last of the wild camels in America met his death in Yuma in 1899, and was eaten by the Indians. The *Evening Star* states, "The venerable beast was one of the herd of camels brought from Asia Minor years ago to carry ore from Comstock mines. So ends the greatest attempt at acclimating foreign animals ever made in the United States."

Another animal which, like the camel, was imported by Congressional appropriation, is the reindeer. In northern sections of Europe and Asia the reindeer had been used as a domestic animal for many generations, but in Arctic America the natives depended upon the wild caribou whose movements were sometimes erratic and whose numbers were subject to fluctuation. Especially the introduction of modern firearms threatened the adequacy of the wild herds upon which the natives were dependent. It was Dr. Sheldon Jackson who on an inspection trip to Alaska in 1890 was principally impressed by the rapidly vanishing sources of food among the Eskimos. Not only was their natural source of food disappearing but what in an Arctic climate is equally important, their clothing as well. Dr. Jackson saw that the United States would soon have to choose between feeding these natives or allowing them to starve to death.

The solution which he proposed involved the importation of domestic reindeer upon which the natives could fall back when wild game became scarce, just as their Siberian neighbors were doing across the Bering Strait; and in 1891 he asked Congress for an appropriation. Congress was not convinced of the wisdom of this project. Private individuals, however, were interested and placed \$2000 at Jackson's disposal for the experiment, and the first shipment of reindeer, consisting of 162

head, was landed at Teller, Alaska, in 1892, not far south of Bering Strait. It was not long, however, before the government was convinced of the importance of this project. During the following decade 1118 more reindeer from Siberia landed on the shore of St. Clarence Bay.

An emergency effort in the winter of 1897-98 had a less fortunate outcome. Rumors reached Washington in December, 1897, that American miners in the Yukon Valley were faced with starvation. Congress commissioned Dr. Sheldon Jackson to visit Norway and Sweden for the purpose of purchasing 500 reindeer with sleds, harness and drivers to haul supplies to the destitute miners. Jackson arrived in Europe the following year and purchased 526 reindeer, secured the services of 68 Lapp drivers, and sailed for New York. Only one animal died on the voyage of 24 days, though the trip was rough and the deer were quartered in open pens on deck. At New York special trains conveyed them across the continent to Seattle without loss of a single animal. Their troubles began, however, when the moss brought from Norway was exhausted. There was a delay in securing transportation to the head of Lynn Canal and further delays when they arrived there. Nearly 300 of the reindeer died of starvation before the moss fields at the head of the Chilkat River were reached. The remaining 200 animals were too weakened to endure the journey to the Yukon Valley and the trip was abandoned. The whole herd eventually died, leaving no progeny.

A success

The project of importing domestic herds, however, succeeded admirably. The deer thrived and increased in numbers. Other herds were formed, and today the barren wastes fronting the Arctic Ocean support vast herds. It is estimated that considerably more than 100,000 animals have been killed for food and clothing, and the crisis which threatened the natives has been averted. The Alaskan reindeer industry is now firmly established and its importance to the people of the Far North is greater than that of the great herds of stock

on the western plains to the people of the United States.

The musk ox

Latest, but we hope not last, of our imported animals is the musk ox. His is not, however, a true importation; it is rather a homecoming, for the musk ox roamed the ranges of northern Alaska in ample numbers until their extermination about a century ago. On September 15, 1930, a herd of 34 young musk oxen arrived in New York on the Norwegian-American Line ship *Bergensvjord*. They had come from Greenland via Norway, and were destined to continue their journey to Fairbanks, Alaska, where it was hoped they would replenish the land with animal life suited to the rigors of the climate.

At Fairbanks a large enclosure provided conditions simulating the natural wild range of musk oxen. The purpose was to study the possibilities of domestication and breeding, with a view to making greater economic use of areas north of timberline.

This experiment represents perhaps the most recent attempt at transplanting and domesticating an animal.

Each attempt, it cannot be denied, served its purpose. The camel died out rather rapidly, and the Texas long horn has passed from the scene to be replaced by a breed more suitable to a prospering cattle industry. Yet, the camel fulfilled his appointed task. He kept faith with those who launched the bold experiment of his importation, and the long horn tided the early cowmen over a trying period.

These cases of transplanting are not the first instances in history where man has bettered his condition and derived impetus for his projects by the intelligent use of the beasts of the field—nor do we believe they will be the last. Man must, however, have an exact knowledge of the animals and their environment to carry out measures that will be to his advantage. If based on misinformation, his schemes will go awry, and result only in much needless waste and cruelty. It is, in part, to perform this service for mankind that the science of mammalogy exists today—constantly furthering the frontiers of its knowledge.

White-lipped Peccary

This distinguished and generally feared inhabitant of tropical American forests becomes a near neighbor of the naturalists on Barro Colorado Island

By FRANK M. CHAPMAN

*Curator of Birds,
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I HAD passed five winters on Barro Colorado Island in the Canal Zone before I saw a white-lipped peccary—locally called "*Puerco del Monte*." The setting was appropriate to the occasion. It was late on the afternoon of March 24, 1931, on a remote, rarely visited part of the Zetek Trail. The ground falls here to make a basin-like amphitheatre set with large trees but with almost no undergrowth; a theatrical kind of place. A light rain was falling, there was no air moving, and the forest had already assumed the impressive possibilities of night.

Just as I reached the rim of the depression the animals made a stage entrance from beneath the trunk of a partly fallen large tree at the right. For a moment I was unable to name them. They seemed much larger than I had expected them to be; and far more impressive than the familiar collared peccary.

A procession

They were traveling in single file and were headed in my direction. I counted seven emerge from beneath the tree and there were evidently others following. Except for a short belt knife I was unarmed. In any event, I was not keen for a closer acquaintance with an animal of *el puerco del monte's* reputation at such short notice. I looked about me for a low-limbed tree but this was not an apple orchard, and a tangle of dripping lianes some fifty feet back on the trail was the only climbable thing nearby. Toward them I gently retreated, so

gently that I almost stepped on a peccary who appeared to have been asleep in the lower growth. Although his reactions were the more obvious to ear and eye, I think that mine were more profound, for at the moment I was peccary-conscious and better prepared to respond. Fortunately, he was sufficiently frightened to retire, for his resting-place was between me and the vines which promised safety.

On closer acquaintance these seemed less scalable than at a distance and I decided to defer my ascent until I saw the head of the peccary procession appear above the border of the basin.

A quiet departure

Several minutes passed; nothing happened and as I cautiously returned to my former lookout, the last member of the peccary file was disappearing to the left. How many had preceded him I do not know. I was not sorry to see them depart and sat down on a log by the trailside to enjoy the impressions created by this long-anticipated experience.

In his life histories of Barro Colorado mammals¹ Enders writes of the white-lipped peccary: "This is the only mammal of the Island that can, by any stretch of the imagination, be considered dangerous, and then only under circumstances which are seldom met." As far as Barro Colorado is concerned our twelve years' occupancy certainly warrants this statement, for in only one season during this period has *el puerco del monte* played a sufficiently prominent part in our lives to win the consideration that history accords him.

¹ Bull. Mus. Comp. Zool., Vol. 78, No. 4, 1935, p. 477.

Of this later, meanwhile our interest in this fellow member of our fauna will be increased if we recall the respect in which he is held by those who know him best.

Sixto Arroyo, or "Mex," a local hunter of wide and high repute, from whom, while our guest on the island, we learned much concerning our mammalian fauna, summed up his general estimate of the white-lipped peccary by saying that "it is always better to leave them alone." In a measure both jaguar and puma, he stated, follow this method, for neither one nor the other will attempt to make a "kill" in a body of peccaries but attack only a single animal or the last one in a passing file. Perhaps for this reason the members of bands attempt to remain closely associated and, when separated, circle about until they are reunited. It is this herding habit, added to its individual aggressiveness and courage, that has won for the white-lipped peccary its place as Public Enemy No. 1 among the mammals of tropical America.

Two kinds of peccaries

When one reads, or hears of hunters who have been treed by peccaries he may be sure that the white-lipped peccary was at the base of the tree. The collared peccary, the other species of this American group, is a smaller, less pugnacious animal which on the island rarely gathers in bands that exceed eight or ten in number. In my experience the collared peccary is diurnal rather than nocturnal, is more evenly distributed and probably more numerous than the white-lipped peccary. For these reasons, of the two, he is far more frequently seen. As I have said, I had been on the island five winters, approximately twenty months, before I encountered a white-lipped peccary, whereas it is a common experience to meet the collared peccary in almost any part of the island. Nevertheless, one always reports the meeting, for after all a peccary is a peccary and until the identification is definite the possibilities of the situation are pleasantly emphasized by attributing to every peccary the habits of the white-lipped.

Once the two peccaries have been seen, and their characters noted, they may thereafter easily be distinguished. The white-lipped is notably larger, has coarser, sparser hair and a whitish band on the lower jaw beneath the

eye, from which it is separated by a blackish area. The collared, in addition to its smaller size, is sleeker, more finely and thickly haired, and bears its name-mark as a narrow, rather indistinct band around the body in advance of the forelegs. The presence, or recent passage of either species to windward, is often betrayed by the musky odor emitted by the dorsal gland; this is much stronger in the larger species. Enders speaks of it as "rather pleasant" "when not too concentrated" in the collared, but as a "stench" in the white-lipped peccary.

Although, on the island, the collared is doubtless the more common of the two species, the difference in their numbers is by no means to be measured by the comparative frequency with which they are seen.

My camera flashlight-traps, set on our trails through the forest, by day as well as night, have captured more white-lipped than collared peccaries. Possibly this is due to the former's apparent preference for our trails while the latter use paths of their own making. Or, the collared peccary, traveling chiefly by day, may see and avoid the trip-wire stretched across the trail which, to the more nocturnal white-lipped, is not visible. I have, however, small belief in this theory. Pumas and ocelots, photographed at night, apparently see the fine hair wire connected with the flashlight batteries, for invariably they attempt to step over it, but a peccary makes no effort to avoid the wire and butts into it head on.

Wallowing

The shallow, bowl-like depression on the Zetek Trail, where, as related, I first met the white-lipped peccary, proved to be one of their headquarters on the island. It had evidently been formed by subterranean drainage which found current expression in a fissure about ten feet deep and as many wide at the bottom of the bowl. Here, even in the heart of the dry season, there were evidences of water. Here the peccaries came to wallow with results that suggested a barnyard rather than the heart of a primeval forest. In vain I tried to secure flashlights of the scenes which it was obvious must be enacted at this place. Luck was against me and the season ended without a satisfactory exposure. The following year the little barranca was dry.

My many visits by day to this place showed

that it was occupied nightly by the mud-bathing peccaries, but, except on the occasion mentioned, I never saw one there. Nevertheless, we have the report of our then headman, Donato, whose word we never had occasion to doubt, that in August, 1927, white-lipped peccaries gathered in large numbers on the Lutz Trail below the laboratory and its connection with the entrance to the Snyder-Molino Trail. Even if we discount the usually conservative Donato's estimate of "five hundred," it is clear from his statement of the ground they occupied that a surprising number of animals had assembled. It is well known that white-lipped peccaries gather in large bodies but the relation of this habit to their annual life cycle is apparently unknown. Possibly it is in some way connected with their mating period.

Rarely seen

Although Donato's observation has not been repeated, a similar phenomenon might readily occur in the more remote parts of the island without our being aware of it. Four thousand acres of densely forested, hilly, barranca-seamed land will conceal many forms of wild life. During my nine seasons on the island I have yet to see either a tapir or ocelot there, and on only two occasions have I met a puma, though we have reason to believe that all three are not uncommon. Indeed, notwithstanding its proved abundance, in only one season since the spring of 1931 have I seen *el puerco del monte*. Then it violated every law concerning its habits that experience had prompted us to formulate. The instance admirably illustrates, not alone the island's attraction, but also its value as an observation post. Year after year, as we return to continue our studies of its undisturbed life, we find how inadequate and misleading is most recorded knowledge of tropical wild-life based on casual or intermittent observations. Certainly, during the season of 1931-32 we had reason to change our previously formed beliefs concerning the habits of the larger of the two peccaries. Returning to Panama on December 2, of the first-named year, I found that the most surprising fact in the news budget that Donato delivered as we crossed from Frijoles to the island, reported the daily presence of *el puerco del monte* in our home clearing. It was midday, the rest-period for bird and beast,

but as the launch slid quietly up to our pier Donato proved his statement by pointing to a small band of white-lipped peccaries grazing in the banana plantation on the north slope of the nearby barranca.

Too interested to do more than watch them, when I decided that the season's activities might as well begin at once, I found that my luggage was already on its tramward way to the laboratory. Hurriedly I followed it up the 196 steps to its destination, extracted a 4 x 5 "Graflex," and returned to the barranca. Then I discovered that a colleague, already in residence, was attempting to film these distinguished visitors in our garden. Without attempt at concealment he slowly approached them up the steep, grassy hillside. The motion-camera at his eye so restricted his field of vision he was not aware that he, also, was being stalked until a charging peccary struck him above the knee. Fortunately, under the force of the blow, he lost his footing, slid down the bank and was thus removed from the danger of further attack. Under the circumstances, I did not envy him an experience which would have been a little strenuous for the first ten minutes of one's return to the field. In place of peccaries I devoted myself, therefore, to photographing Swainson's and Ari-cari toucans from beneath the revised "Shannon Shack." The birds were visiting a nearby papaya to feed on the growing fruit which proved to have been softened by the attack of a fruit-fly. Here was a second novel observation and I had not yet been home, so to speak, long enough to remove my hat.

Failure of food supply

This was my first day of what proved to be a peccary winter. Unusually heavy rains at critical periods during the preceding wet season had apparently prevented the fruiting of certain trees that supply peccaries and other animals with food. The rainfall for the year was 123.30 and for November 30.84 inches, of which 23.82 inches fell between the sixth and tenth of the month. But, whatever the cause, there appeared to be an undoubted lack of forest food. Almendro nuts, for example, a favorite fare of peccaries, were almost entirely lacking. These animals, therefore, were evidently forced to range far for food and to hunt by day as well as by night. That they

suffered for lack of nourishment is indicated by the accompanying flashlight of a white-lipped peccary secured near Fuertes' House where the species had not been before recorded. Compared with earlier pictures, made during seasons of plenty, this animal appears to be on the verge of starvation.

It was doubtless this failure of the normal food supply that induced these inhabitants of the wilder parts of the island to visit our clearing to graze on the grasses and grub up our root crops. A young boar and two sows, probably members of the band I saw the day of my arrival, attached themselves to the immediate vicinity of the laboratory, where their presence added in no small degree to our interest in the local fauna. They made their headquarters in the shade of a bread fruit tree where the discharge from a waste-pipe supplied conditions for what looked like an ideal wallow. A foot-path passed nearby but to avoid disturbing our guests it was not used while they were bathing.

On one occasion, at noon, I attempted to make a close up, tripod picture of the trio at rest here, but the male started toward me with so evident a determination to prevent this intrusion on his family life that I deserted my camera. The photograph was secured, however, later in the day.

Fear'd by other animals

Two native, semi-domesticated members of our household showed a pronounced and evidently instinctive fear of these peccaries. One, an adult male curassow (*Crax*), was intensely excited by their proximity to his quarters, even though he could perch far above their reach. The other, a usually fearless, mature white-tailed doe, exhibited paroxysms of fright when her nose warned her that a peccary was nearby. Springing to the ceiling of her 8-foot high cage she rebounded to its cement floor with a violence that threatened to break her back. Always we rushed to her rescue.

Unless *el puerco del monte* is at times predatory it is difficult to explain the fear he aroused in these, his forest-mates. An observation made early on the morning of February 1, 1932, seems pertinent. At that time I heard a peccary, probably one of our trio, with whose voices we had become familiar, surprise some creature in the dense growth of the adjoining

woods. What followed was typical of many unseen tragedies of a tropical forest—a short chase, capture, agonized screams, silence. I was unable to find the victim.

Returning with my bearer Miguel from a camera tapir-hunt on the morning of January 31, 1932, I found two of our peccary visitors grazing on the hand's-breadth of grass between my doorstep and the forest. Assuming that they would retreat I advanced confidently. But the boar was not disposed to recognize my right of way. With dorsal bristles erect and champing loudly he not alone held his ground but advanced to the attack. Armed only with a butterfly net I, therefore, conceded the post of honor to Miguel, who, besides a Nesbit camera, carried the usual machete. Concealing his elation at our change of positions Miguel, shouting loudly, waved his weapon valiantly and when we were at a distance of about ten feet the peccary reluctantly gave way and permitted me to enter my house. But when, less than three minutes later, I emerged to descend to the laboratory for a shower, the peccaries had returned and were again prepared to dispute my passage. With no Miguel to call on I tossed an empty bottle at the boar. It landed squarely on his nose. He jumped a bit but apparently was neither hurt nor surprised and came back at once to smell of the bottle. Then, indeed, there was a reaction. With a great chomp and squeal he sprang back so suddenly that he knocked the female behind him completely over and continued on his flight to the forest. The bottle, I should add, had contained only water and it seemed evident that the animal had recoiled from the scent of my hand.

Not permanent visitors

If thus we were at times somewhat inconvenienced by the actions of our nonconformist guests, we realized that their presence offered us an exceptional opportunity to live on more or less intimate terms with animals which, as a rule, man encounters only to kill. Pursuant to Barro Colorado's hospitable custom we, therefore, tried to meet them on their terms with the hope of establishing relations that would be mutually acceptable. But they have never returned, and life about the laboratory now lacks an element of uncertainty that added not a little to its charm.



FIVE WINTERS had passed on Barro Colorado Island in the Canal Zone before Doctor Chapman caught a glimpse of this interesting animal. Unusual circumstances offered the

opportunity to live on more or less intimate terms with a creature which man usually encounters only to kill

White-lipped Peccary

SELF-MADE FLASHLIGHT PHOTOGRAPH. Failure of the forest food crop apparently brought the peccaries to the half-starved condition shown by the animal in this photograph



(Right) LESS PUGNACIOUS than the white-lipped peccary is the collared peccary. Lacking the whitish band on the lower jaw of its larger cousin, the collared variety possesses an indistinct band around the body in advance of the fore-legs, visible on the right-hand animal

Collared Peccaries

A COLLARED PECCARY on the Wheeler Trail near an alnendro tree, the nuts of which are a favorite food of this animal. Note the sleek coat as compared with that of the white-lipped peccary opposite



A BAND OF SIX collared peccaries feeding on a hillside. The white-lipped peccary is more nocturnal in its habits, and probably not so numerous which accounts for his being less frequently observed

Andorra, a Country in the Past

On the border of Spain, where revolution is disrupting the ancient order, one of the world's smallest countries clings to medieval ways

By LAWRENCE FERNSWORTH

Correspondent of "The London Times"

Drawings by AGNES C. LEHMAN

FOLLOW me up the valley of the Valira del Nord through tiny independent Andorra. This scrap of a country, hiding back in the Pyrenees between France and Spain, is like a sample clipped out of the Middle Ages and transplanted in the modern world.

I reach the last cluster of houses in the valley. This is the *cortals* or high mountain village of Llo Serrat, a small settlement that will be deserted in winter. The crude black buildings seem to cling to the rock like so many barnacles. Smoke is coming from the *cabana*, and I knock at the door. The boy who opens it looks startled, but he greets me with an engagingly frank smile and bids me enter.

He was clad in a rough shirt and corduroy pants which came high up his waist. In a few moments he was joined by two younger brothers who came running from the barn. I broke two eggs and fried them over the fire for my breakfast. The boys sat eyeing me shyly. Occasionally the oldest passed me his wine bag. I handed them some cakes which they devoured.

First citizen

Finally my young host spoke. He told me that he lived here all the year round except during December and January when the snow was too deep and the cold too bitter. His task was to look after the mule herds and keep an eye on the *cortals*. Two or three months of this period he was almost always alone. I told

him that he was the *batlle* or mayor. All three laughed.

Before departing I asked him for my bill. "Two dollars," said my host. I had told him that I was an American and he seemed to know that Americans used dollars. "But how much in *pesetas*?" I asked. "Two *pesetas*," he replied. Encouraged by this favorable rate of exchange, two *pesetas* being twenty cents, I decided to take another plunge into the Llo Serrat money market, so I inquired the price in francs. "Two francs," was the snappy quotation, which was about eight cents. I struck an equitable balance. But I shuddered to think what might happen to some Englishman who might be charged in pounds and not have the happy thought of playing for a more favorable exchange.

Living in the long ago

Andorra is the last of Europe's feudal states. It claims Charlemagne as its "Great Father" and the author of its liberties. While the rest of the world has been moving forward, it has been clinging to the ways of another age, so that entering there and beholding its strange customs is like making a journey into a tight little world of long ago.

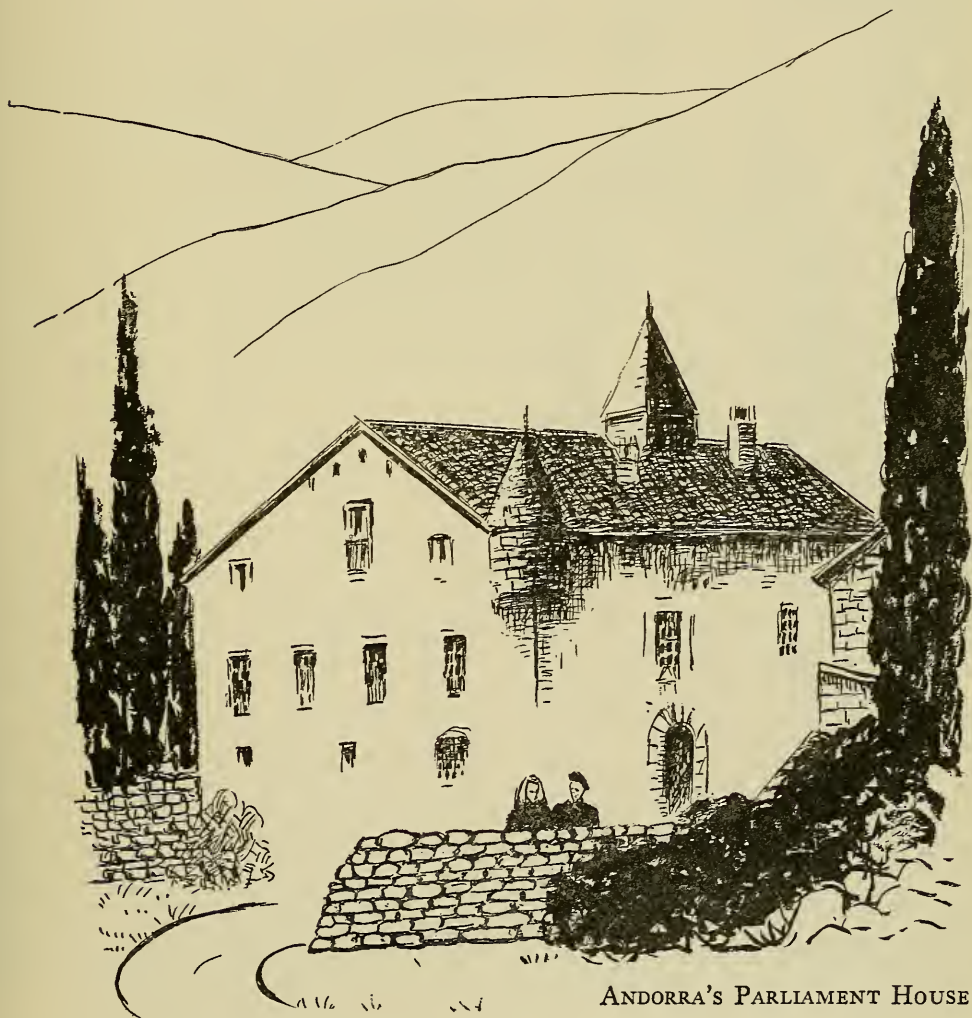
Andorra is a land of sharp towering mountains, of high grazing plateaus, of deep green valleys, and of rugged gorges through which angry waters are forever pounding. It slopes down toward Spain into which it has a natural gateway near La Seo de Urgel. The country has two valleys, each traversed by a river: the Valira del Nord and the Valira del Orient. These valleys come together to form a Y, the stem of which is thereafter known as the Gran

Valira. Along these valleys lie villages and the six capitals of the six parishes, also called *communes*.

Andorra is called a republic and has a chief of state commonly referred to as the President, although his official title is "The Most Illustrious Syndic and Procurator General of the Valleys of Andorra." The real title of the state is the Valleys of Andorra. One of the co-princes to whom Andorrans do homage is nominally the President of France, although in reality the French Government has long ago, and with doubtful legal and moral propriety, taken over his functions, a fact much objected to by Andorrans. The other is a prelate of the Church, the Bishop of La Seo de Urgel, the only ecclesiastical authority outside the Vatican

still exercising both a spiritual and temporal jurisdiction. For many centuries the Bishop of Urgel has resided in Andorra's "Spanish Capital," called La Seo for short.

The Most Illustrious First Syndic presides over the so-called Council General, a kind of legislative, administrative and judicial body rolled into one. It meets at four stated times of the year in the House of the Valleys at Andorra la Vella, and is composed of twenty-four councillors, four from each of the six parishes. Afoot or on mules, the councillors were wont to come in the days before the automobile and motor bus, the first councillor of each of the six communes bringing with him the key and the *llet*. The *llet* is cash representing each commune's share of the cost of properly enter-



ANDORRA'S PARLIAMENT HOUSE



PRESIDENT'S HOUSE, ANDORRA

taining councillors while in session. The six keys are for opening the great oaken chest that contains the national archives. Until all six councillors have come with their six keys the chest cannot be opened and the government cannot function.

The members wear long, flowing robes with curious flat, black hats having wide brims. There is an unwritten law that each councillor must come wearing a black tie. If he overlooks this formality he is admonished, and mayhap fined, by the Syndic, and sent out to get one.

The usages and customs require that the members of the council, once in session, shall not leave the capitol building until their busi-

ness is concluded, and that their sessions be held in strict secrecy. Until the recent Youth's Revolution, the rule was observed and if there was likelihood that the sessions would last longer than a day, the men brought their blankets with them. There is in the House of the Valleys a great kitchen with a fireplace and spit in the center of the room suitable for the roasting of half an ox. Adjoining it is a dining salon, a rectangular piece down the center of which runs a wooden table flanked by benches. It is still the banquet hall for state occasions. There is also a chapel adjoining the session chamber, and there is a rule that each meeting of the Council must be inaugurated with the

celebration of the mass. The six communes which the councillors represent are like six little countries in a world of their own. They have their quarrels and rivalries, their alliances and leagues, and it is even of record that once they went to war with each other, one and one-half of the communes remaining neutral.

Andorrans call themselves *Catalans de pur cep*—of pure vintage—by which it may be taken that they consider themselves free of Jewish, Moorish, and other infiltration to which Catalan blood of the lowlands has been subjected. No doubt they are a vintage of Frankish, Visigoth and other stock that preceded them. When the Moors began wiping out the Visigoths in the tenth century, it is of record that many of the latter retreated to the fastnesses of the Pyrenees and there successfully defied their persecutors. I have seen eleventh and twelfth century records bearing the names of families which still live in Andorra in the same localities.

During the centuries, I am told, the population never exceeded five thousand, though at least until recently, with the opportunities offered by the travelers, there has been a continuous exodus of youth seeking their fortunes elsewhere. By Andorran law they are forever Andorrans, as likewise are their wives and children no matter where born.

Andorra is the land of patriarchs. The head of the house, the *cap de casa*, is the guardian of the customs, the giver of laws, the wise man in times of danger, and, in his own humble way, a prophet. These men constitute Andorra's most distinctive institution.

Land a sacred possession

Land is the life of an Andorran, and is so limited that it has commonly been regarded as more valuable than gold or animals. Gold and animals may disappear but the land stands forever. To sell it is either a disgrace or a misfortune; and if for any reason an Andorran or his ancestor has ever had to part with it, it was given as a sort of pledge for debt with the right to redeem it even after a lapse of centuries. With the recent invasion of "civilizing" influences, however, the transfer of small parcels of land has become frequent.

It was out of the necessity for conserving the land that the family, which is the chief unit of the Andorran social group, derived its

character. It is the rôle of the head of the house to transmit the centuries-old traditions of his house. The house is an immutable institution which preserves its name for all time, even though the family name change. The *cap de casa's* children, and their children, live under his rule so long as they remain on the land. The day will come when one of them will be his heir, inheriting the land, inheriting the rôle of upholding the family prestige, inheriting the title of chief. The heir is usually the eldest son but the *cap* may name another should he deem him more fit to carry on in the traditional manner.

The Andorran heiress

It sometimes happens that the inheritance devolves upon a girl of the family. Such a one is known as a *pubilla*, and she is much sought after. It is almost a foregone conclusion that she will marry the heir of some other family. The heir, in that case, becomes the *cap* of the two houses, uniting them, but only for the time of the union. Both the *cap* and the *pubilla* will have their respective heirs after them, each heir becoming the *cap* of his own house, as of yore. If a *pubilla* marry a stranger, he becomes by that fact an Andorran.

Andorran houses, for the most part, are primitive affairs built of slabs of black slate laid one upon the other and ribbed and buttressed with timbers from the forests. They are topped with low-lying slate roofs, usually of the gable variety. Half-way across their façades are odd-looking balconies of roughly hewn wood. In many cases there is one such balcony at each upper story, beginning at alternate sides and ending in the center. Frequently iron grille work, reminiscent of the country's abandoned forges, replaces the wood.

That an advanced phase of building science was not unknown to the early Andorrans is proved by the arches of the bridges which with symmetrical backs humped over a stream, are to be found in all parts of the country. The same is true of the churches which are of an early romance style. Bridges and churches date from very long ago.

The interiors of Andorran houses are as quaint and cozy as they are primitive. Many of the smaller ones have only one story, in which case the fireplace is on the bare ground under a chimney. Furniture is scant but neatly

arranged. One of the curious features in the great rooms which so often are kitchen, dining and sitting room, all in one, are the wooden racks for holding pewter spoons and forks. There are little slits in the rack, one for each piece. Over the fireplace are always two large pots. One is for the hot water, one



savoring of leather, and squirted into the mouth from a wine bag. He almost never has tea or coffee, although if he has a cow or a goat, he may enjoy the luxury of milk. The Most Illustrious Syndic had two cows, Blanca and Negra, which did duty as oxen during the day, and which, the day's work done, he unyoked and milked.

Andorra is a land of four well-marked seasons. Spring comes almost imperceptibly in her rightful time, a shy soft lady emerging from her winter's mantle of ermine. She brings mountain flowers of glorious richness and color. Summer is a bright-eyed youth, clear of complexion and soft of breath, offering mild warmth, tarrying for a full measured season. Autumn is a gay, engaging urchin, coming in a time of fairs and dancing, not flying his colors too soon, lingering long. Winter follows, decking her mountains, her valleys, her forests, with mantles of snow. This, like the other seasons, is a time of beauty and delight. There are cold grey days, it is true, but there are long series of days when the sun shines brightly through blue cloudless skies, while encircling peaks protect the little valleys from wind, so that the air is warm during the hours of sunshine and one sometimes tramps out of doors in shirtsleeves.

At night the peasant lays himself down on the hay of the *bordes*. In even the largest of these mountain villages, containing perhaps a

for the family soup; and if there be a third it is usually for the cooking of feed for hogs.

Turnips are a staple article of diet for hogs but are considered unfit for humans. It was only after considerable urging that I could induce the family at whose *posada* one winter I was staying, to boil me some turnips, other vegetables being scant. They were good, but it nevertheless became a topic of conversation in the villages that I had strange tastes in the matter of food.

Soup of ham broth, hard black bread and potatoes constitute the Andorran's most regular diet. Other foods, such as mutton chops or codfish, esteemed a great delicacy, are fried over the coals or grilled on the spit. Sometimes this fare is varied by a civet or wild isard or broiled mountain trout. It is really astonishing what an elaborate meal the Andorran housewife can cook in this manner, once she sets herself about it.

Once when I was visiting the *cabana* of the Most Illustrious Syndic, the latter attended to the honors of making the soup. The soup is usually ham broth, and is rarely modified by vegetables or other meat. When it is ready, the soup is poured over hard black bread, cut up in a bowl. This forms the farmer's diet, morning, noon, and night, while he is up in the higher hamlets. His drink is black wine,



score of *bordes* with their *cabanas* there will not be found one solitary bed. Cozy places they are in which to sit on the little wooden benches by the fire with its cheering warmth, its odor of burning wood, while the pitch torch, stuck in a slab of slate that projects from the wall, burns and flickers casting odd shadows about.

Andorrans are of lithe and muscular build, like their donkeys. They have bronzed, regular features and bright eyes that are frequently greyish. Little remains of the quaint habili-ment they once wore, their *barretina* of flow-ing and tasseled crimson, their tight pants and white leggings, their black sash, their coat of black velvet. Mostly Andorrans now wear home-made suits of corduroy, although fre-quently retaining the black cincture, which is wound round, and round, and round again, at the waist. Andorrans don't like suspenders, as to which they have invented a tongue-twister: "*Els elastics em fan fastics*," meaning "Suspenders give me a pain." They have taken to the European, or American-style cap, wide, overhanging in front. In fair weather their feet are shod with shoes made of canvas, and of thin cord rope for the soles, these being easier for tramping over hard round cobbles, and seeming to lend to the wearers a certain nimbleness of hoof.

The women are slender, sinewy, bronzed, like their menfolk. And like the men they work in the fields or carry burdens along mountain trails. Picturesque, even pathetic, one thinks, these little women in black whom one sees at the labors described, or at such tasks as turning green hay in the fields with their wooden forks, herding a drove of cattle down from the mountains, driving a donkey along a high trail, themselves burdened with a load, like the donkeys. But always cheerful and ready to smile, never complaining. When they go to church on Sunday they vary their dress, always black, by the wearing of flowing



black veils over their heads, giving them the appearance of nuns. Their daughters, however, affect raiment more vivid and gay. But the time will come for them to abandon their colors, to take their place with the women, carrying their burdens, doing their share of the family toil.

The women play an extremely minor rôle in the life of the family. Usually they eat in the kitchen after the men have taken their meals. On the other hand, even the humblest man-servant eats at the same table with the *cap*. I have not observed, however, that wo-man's minor rôle arises out of any pronounced



notion of her inferiority. It is merely a scheme of things that seems to fit in naturally, bio-logically, and so is accepted without much thought on the matter. The attitude of the men toward the women is considerate. I have seen the men helping their women with house-hold and kitchen duties, cutting the meat, dry-ing the dishes, and even taking a hand at the cooking. It is essential for the men to know something about household duties, for they pass much time isolated in their mountain *cabanas*.

The Andorrans devote themselves to the raising of hay, grain, tobacco and stock. The tobacco is made into bad cigars and rasping cigarettes or rough pipe tobacco. The ciga-rettes are put up in fancy packages imitating the American brands, but that is the only thing fancy about them.

The mules, which graze in the high pas-tures, are sold every fall at the fairs of the villages to buyers from Spain, or are taken to other fairs across the Spanish border. They

constitute an important source of income. Great rivers of sheep come up in the last days of each springtime to graze in the mountains, returning again in the chilling days of autumn. Mostly they come from Spain, but some flocks also cross over from France. They graze on the public lands for a consideration paid to the communes, this being an important source of public revenue in a land which traditionally has been without taxes. On the import side, Andorra buys much of its food, such as eggs, fresh meat, fresh and salt fish, including codfish, fruits, vegetables, olive oils, wine, as well as articles for household and field, from Spain, and, in lesser degree during the open season, from France.

Resources

Forests are one of its most important resources. The mountains are covered with fine pine. While there is an official conservation policy, in recent years quantities of timber have been cut down and sent out into Spain and one wonders whether the unwritten law of timber conservation is now not more honored in the breach than the observance.

The land has important iron deposits. Indeed iron mines were once scattered all over the country, and their products fashioned at crude forges. Geologists state that the region also has nickel, lead, copper and tin. Water, however, is Andorra's most important visible resource. It tumbles down in streams and cataracts on every hand, and has already been harnessed for the production of electric power in untold measure to provide added energy for the Catalan industrial centers.

Water plays an important rôle also in irrigation. It is caught up on every hand in canals called *reches*, which tap the streams in their upper courses and carry it sliding along high slopes and about mountain sides.

Only within the past few years has modern civilization begun to rap gently at Andorra's door. A highway, completed in the fall of 1932, has pierced its mountain barriers. It traverses the country from the French border to the Spanish. Traffic on it can be maintained during five or six months of the year depending on weather conditions.

This road is the way for civilizing influences and new longings are felt in the country of Andorra. There has recently been a revolution in which youth demanded the right to

vote and hold office. Previously only the *caps* had this right. The *caps* opposed the demands of the youth, for it is their traditional rôle to guard the unwritten code of usages and customs, to see that they are transmitted from one generation to the next without change, and to see that they are observed by the public officers, by the Council General, and by the law courts. (Although the laws are unwritten there exist two manuscripts, *résumés* of the same, the *Politar* and the *Digest*, the former of which is the more generic and complete and is accepted as authoritative.) Reluctant to relinquish their special privileges, the *caps* have shown a disposition to renege on the concession wrung from them by force. So long have they been master that they are inclined to regard youth with contempt. But Andorran youth are determined and the victory would seem to be theirs.

An awakening country

A further result of contact with the outside world was an "invasion" of French gendarmes to assert French "authority." This the Andorrans resisted and continued to resist; there sprang up a nationalistic movement within the country which increasingly demands a complete severance of the ties which place Andorra under the tutelage of its co-princes, the President of France and the Bishop of La Seo de Urgel. And as this article is written the nationalistic party is preparing, in the face of opposition on the part of the co-princes, to present to a plebiscite of the people a new constitution which shall bring their unwritten code more in harmony with a modern day.

These are the political stirrings which civilization's belated arrival has caused in Andorra, and the present disturbances in Spain will doubtless further affect the little republic to some extent.

But although certain surface aspects of Andorran life have been affected the country has not really changed much underneath. Oxen plowing fields on mountain sides with wooden plows, tipped with a bit of steel; grain threshed by hand; the pitch torch and other primitive utilities and ways already described—these remain. Side by side with them are a few touches of modern progress, chiefly the automobile and electricity in the villages that are close to the new power lines. But the na-

tive largely sticks to his donkey. When the Andorran farmer goes plowing, he loads his plow on the back of his donkey and drives it up to the fields over laborious trails. And even over the new highway, in places where until a few years ago the natives had never



seen an automobile, you will see donkeys or mules piled high with merchandise—with tables, bales or boxes of goods, a cart wheel, even a sheep or a hog slung across the saddle, or the ubiquitous sewing machine. This latter convenience is found in the most remote reaches of Europe, and one is tempted to say that it has gone just a little ahead of civilization. In Andorra the sewing machine is so generally of a well-known make that the housewife most commonly refers to it simply as her “Sink-err.”

The high fields are patchwork of earth laboriously, patiently grubbed out from amid

rock and brush, and sometimes slant so much that they seem ready to slide away into a ravine. The grain and hay is cut with old-fashion scythes and sickles. It is turned to the sun or loaded on the animals by means of wooden pitchforks cut out of the pronged limbs of trees. Flat wooden racks, provided with canvas flaps, are placed across the backs of donkeys and mules for the loading of hay and grain, and by means of them the animals can be weighted down with loads several times their weight.

I am not one of those who feel that Andorra will soon be spoiled by its highway. Andorra will always have its peaks and lakes and the trails that lead to them; its streams forever singing; its forest valleys with their streams tumbling down between craggy walls in turbulent pell-mell, laughing forever at man's efforts to tame them. The new road will attract a certain number of more venturesome European travelers who are lured from the beaten trails by the possibility of seeing one of the smallest countries in the world and one of the few niches where ways of the Middle Ages have lived into the present. But Andorra is not going to step into the twentieth century overnight.



See Martin Johnson's illustrated story of his recent expedition to Borneo in next month's *New NATURAL HISTORY*



INNUMERABLE CHURCHES *dot the rugged landscape of Andorra, which largely owe their support to the bequests of citizens who died*


centuries ago. Many of them are abandoned or are visited by the priest but once a year to comply with the age-old bequests

AN ANDORRAN PEASANT TEAM. *There are eleventh and twelfth century records bearing the names of Andorran families still living in the same localities*



Andorra, a Country in the Past

ALL PHOTOGRAPHS BY LAWRENCE A. FERNSWORTH



HIDING BACK IN THE PYRENEES between France and Spain among peaks towering to 9000 feet, Andorra has for centuries clung to the ways of long ago. It is one of the smallest countries in the world and is the last of Europe's feudal states. The President of the republic presides over a Council General, a combined legislative, administrative and judicial body, in the transactions of which quaint formalities are observed. Once in session, the members may not leave the capitol building, and until recently they brought their blankets with them. The meetings are held in strict secret, and the six communes which the councillors represent are like six little separate countries in a world of their own. The President, like the representatives, in private life pursues the simple pastoral activities of his ancient forefathers, owning two cows which are yoked like oxen during the day and milked at night.

The Andorrans do homage nominally to the President of France, and to the Bishop of La Seo de Urgel in Spain, the only ecclesiastical authority outside the Vatican exercising both spiritual and temporal jurisdiction. Present disturbances in Spain will no doubt resound in Andorra, but it is hoped that this relic of the Middle Ages surviving in the modern world will long retain the charm of antiquity

THE OLD HERMITAGE of San Antoni in the gorge of that name. Four years ago a motor highway pierced the mountain barriers of An-

dorra; but winter snows block it half the year, and many of the most charming spots are accessible only on foot





(Above) TILLING THE ROUGH LAND is a major activity. The Andorrans devote themselves to the raising of hay, grain, tobacco and stock. Irrigation plays an important rôle

(Lower left) ONE OF ANDORRA'S innumerable churches

(Lower right) ONE WONDERS if these children, unlike their parents, will grow up in a modern world





(Above) GREAT RIVERS OF SHEEP come up from France and Spain in the last days of springtime to graze in the mountains, providing an important source of public revenue

(Below) THE SUMMER HOME OF THE PRESIDENT of Andorra (in the foreground). The high mountain villages of which this one is typical are inhabited only in summer and early fall





(Above) A CORNER IN AN ANDORRAN VILLAGE. The houses are built of slabs of stone and frequently display odd-looking balconies of roughly hewn wood



(Above) AN ANDORRAN PATRIARCH. Deeply respected men of this class constitute Andorra's most distinctive institution

(Below) ANCIENT STONE BRIDGES are a common sight



PICTURESQUE
ARCHITECTURE *pre-*
sents pleasing vistas
against the rugged
skyline



(Right) ANDORRA'S
WHITE HOUSE: *The*
residence of the new
President, Sr. Pere
Torres. Strangely
enough it is one of
the few literally
white houses in An-
dorra



THE NEW MOTOR ROAD and the gradual introduction of modern mechanical conveniences may mark a new day in Andorran his-

(Right and below) THE HERMIT OF MERITXELL, Andorra's only remaining hermit. Andorrans are lithe and muscular, with bright eyes that are often greyish



tory, but the country will always have its peaks, lakes, and mountain trails, and its picturesque historical background

(Bottom center) A VILLAGE FAIR, at which buyers from Spain are likely to purchase many Andorran mules

(Below) FLOWING BLACK VEILS are the Sunday fashion





All photographs by Croy from Black S

The Flesh Fly

THESE COSMOPOLITAN FLIES are general scavengers and owe their name to the habit of depositing the larvae (or rarely eggs) on meat or on the wounds of living animals. In some parts of the world domestic animals and even

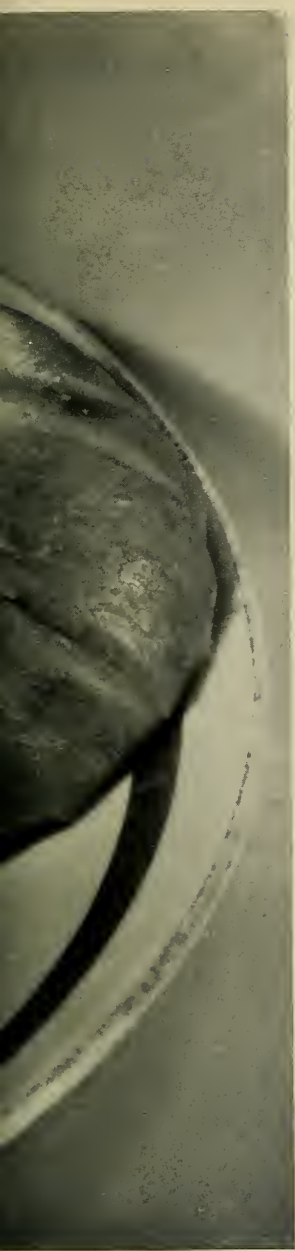
man suffer greatly as a result of open wounds becoming infested with the larvae

The life cycle of the insect, illustrated in the following pages, is very rapid during warm weather



WHEREVER MEAT LIES for some time the flesh fly is liable to appear to deposit the larvae or eggs. Such forms as visit kitchens or camps may

cause intestinal myiasis in man as a result of eating cooked meat that has become infested



(Below) A SMALL HEAP OF EGGS, enlarged about 35 times, which will hatch within a few hours. It is unusual for the flesh fly to lay eggs at all, for the latter usually hatch in the ovaries, causing living maggots to be deposited





(Above) THE SLENDER NEW-BORN MAGGOTS, upon reaching the meat, usually bore within and begin feeding

These maggots differ from the ones that are used beneficially in the treatment of infected wounds in that the latter do not attack living flesh. The fact that the flesh fly often deposits its larvae on fresh corpses before decomposition has set in has caused it to figure in medicolegal testimony

(Below) GROWTH IS RAPID in the larval stage, which occupies from one week to one month. When full-grown the outer skin hardens and pupation takes place within





(Above) THE PUPAL STAGE. Inside the puparium, transformation into the adult fly takes place. Usually the pupal stage lasts for from seven to eighteen days (in summer), but in temperate zones it continues through the winter



(Left) THE PUPA extracted from the puparium in an intermediate stage: the mysterious process of metamorphosis is going on within



THE ADULT FLY EMERGES two to five weeks after the eggs or larvae were deposited (except when the winter is passed in the pupal stage). In the above photograph the wings are not yet

unfolded, but the transformation of the fly is complete. After the wings have hardened it will fly away and in several days will lay eggs or larvae, thus renewing the cycle

The Penitentes

Without church sanction, a cult within our borders annually performs a grim ritual of self torture culminating in the crucifixion re-enacted

By FLORENCE MAY

“DOWN in the sand hills of New Mexico—” Those sand hills contain many more strange and wonderful things than the Indian maid who was glorified in the popular ballad of twenty years ago. Such things, for instance, as: the Carlsbad Caverns, the Frijoles cliff dwellings, and the Penitentes.

The Penitentes do not compare with the magnificence and beauty of the natural physical wonders of New Mexico, but this fantastic group of Mexican-Indians comprise a vital element of the peculiar charm that seems to rise from the very soil of this unusual state. The practices and ancestry of these natives go further back than any recorded history; so that they are one with the secret, brooding hills which they inhabit.

Origin

Self-flagellation is the creed and chief reason for existence of the order Los Hermanos Penitentes (The Penitent Brothers). Self-torture for expiation of sin was a barbaric practice in the early history of nearly every ancient civilization. To understand its presence in modern New Mexico requires some brief scanning of history and some logical conjecture on the gaps left by early records.

The first Spanish conquerors to reach northern New Mexico in the search for the Seven Cities of Cibola brought with them courageous priests of the Franciscan order. The followers of the Third Order of St. Francis were familiar with self-torture as practised by members of their order during its early

years. Such barbarism had been suppressed by the church, but the pioneering priests were quick to recognize in the ceremonials of the aborigines a similarity to those of the Third Order. It was practical wisdom on their part to begin their efforts to civilize the Indians with symbols of Christ which compared with the stoicism of the savage tribes. The aboriginal mind was swift in grasping the drama and imagery of a crucified Christ. Though the Indians repeatedly accepted and rejected the patient friars through the violent conquests and rebellions of the pueblos, this impression persisted. Of the period between 1598, when Onate first established Spanish conquest of New Mexico, and 1794, when Father Bernal sent the first detailed report of the status of the church in New Mexico to the Governor of Old Mexico, the only remnants of the good Franciscan's efforts were the practices of the Third Order and the re-enactment of the passion and death of Christ as perpetuated by the Penitent Brothers. After this time the order became gradually more secret, as its practices were more frowned upon by the church; and in 1886 this disapproval culminated in the issue of a diocesan order forbidding the celebration of mass in the Penitente chapels.

Prominent citizens

The fact that the church repudiated them did not particularly disturb the Penitentes. With increasing population of the state and consequent introduction of civilized law and order, they have drawn farther into the mountains and modified the rigid adherence to detail in reenactment of the grim passion play

which characterized its early history. It is quite impossible to be certain of the exact number of American citizens who participate in the bloody rites each year. To be sure, it is known that as recent as 1890 certain men prominent in the political affairs of the state were sworn into the brotherhood.

The Brothers are found chiefly in small villages near Taos, Mora, and Abiquiu, and in Los Griegos near Albuquerque. The *morada* (council house) is, in fact, a chapel, and is the central building in these villages, though often in the more thickly populated districts it is well-disguised and hidden. Each group has an *hermano mayor* (elder brother) who is law-maker, judge, and high priest; an *infermo*, who attends the sick; a *resador*, who recites the prayers; and a *cantador*, who sings the ancient chants written in sixteenth century Spanish.

Cactus whipping

The annual ceremonies which comprise practically the only activity of the order take place from the first Friday of Lent to Easter morning. All members do not participate in the formal ceremonies every year as there is a rotary system whereby each has his turn every three or four years. Each Friday night throughout Lent the eerie sound of the *pito* (primitive reed flute), with its Oriental grouping of notes and its Gregorian idea of tune, leads the *flagellantes* up the Rastro de la Sangre (Path of Blood) to El Calvario, a hill of rotting crosses of previous years. The participants wear only a breech cloth of white cotton and a crude head mask which serves the dual purpose of increasing humility and preventing recognition. The penitents flog themselves pitilessly with the *disciplina*, a whip made of thongs of yucca cactus leaves from which the fibrous matter has been stripped.

Along the weary trail of punishment the queer rhythmic drag and shuffle of feet, accentuated by the sickening sound of the vicious whip as it is swung first over one shoulder and then over the other, fills the mountain stillness with chilling tensity. If there is a break in the perfect precision, the brother who has fainted is assisted by the *hermanos de luz* (brothers of light) whose duty it is to sustain the self-torturers. If, however, he merely falters he is flogged by the *sangrador*

who walks beside the procession lending the urgency of vigilance to the fervor of the penitents.

As Easter week draws near, the number of participants in the formal processions increases, and other ingenious forms of self-inflicted penance are performed by the entire community. Severe fasting is universal throughout Lent but in this final week it becomes more stringent. Such ghastly practices as dancing or crawling on cactus beds, hugging the *cholla* (barrel cactus), and carrying huge, rough-hewn crosses are common in these last days when the exaltation of atonement is at fever height.

The Holy Week of Christianity is celebrated by the Penitent Brothers with savage ceremonies which climax the horrible Lenten activities. Holy Tuesday services consist in the renewal of faith in which the members receive the "seal of obligation" of the order—three gashes down and across on the back, by a crude knife of broken glass or rock set just deep enough in its wooden handle so that it will not sever the muscles of the back. The more devout and sturdy members request additional gashes for the three meditations, the five wounds, the seven last words, and the forty days.

Ash Wednesday and Holy Thursday are spent in singing and praying by processions of scourged penitents who repeatedly make the way of the cross to the *campo santo* (burial ground) and *calvario* on knees or bleeding bare feet; always accompanied by the spine-tingling flute and the weird rattle of the *metraca* (a wooden noise-maker, "thunder-twirler").

The Cross

The crucifixion, which is the high point of all the frenzied ceremony that has gone before, takes place Holy Thursday at midnight. The chosen *Cristo* drags his heavy wooden cross to the spot, absolutely secret, where the drama is to take place. Where in years past the one so honored was realistically pinned to the cross with nails through the full three hours, he is now bound by rope or leather and remains hanging only forty-five minutes, as it has been found that the circulation completely stops after this time. The favored individual is swathed in white from head to foot to prevent recognition, and if

he dies (which is rare unless he has been terribly weakened by fasting and loss of blood in the Lenten scourging) his burial is secret and even his family is not aware of it until his clothing is returned to them. This final atrocity ended, the members accompany the crucified one along the road back to the *morada*. If he is able he carries his cross back with him, or is aided in doing so by the brothers of light, and it is placed among the others on El Calvario. At the *morada* the long fasting is broken with rough plain food and the members rest their weary broken bodies while the *infermo* attends the more desperately wounded. Some of the hardier members continue through Friday or Saturday with the solemn and involved *tinieblas*, a ceremony which seems to commemorate the three hours of Jerusalem, though its inception is so blurred that the brothers themselves are not quite clear on the subject. Here there is no glory, no happiness as in the orthodox Eastertide. True, some of the communities celebrate Easter Sunday in a manner somewhat approximate to their simpler neighbors. Their children often receive communion in white dresses and carry candles in attractive Easter processions, but the dark undercurrent of deadly seriousness invades even the innocence of the children.

Death penalty

There is little to add: the Penitente is a quiet law-abiding citizen throughout most of the year with no more important vices than his neighbors. The laws of the order are very stringent as regards their conduct toward each other. An offense against an outsider is not noticed or punished, but the slightest breach of form in the relations between members of the order brings swift and severe justice. The endurance of the men being so well known there are few possible punishments besides death, and this is decided upon usually for almost any crime from corn stealing to horse or wife thievery. Honor among thieves? Perhaps, but it is a code, and one difficult for anyone to understand who has not observed the natives of this district at length.

The reality of the yearly Penitente ceremonial is attested to by any number of reliable residents of the state who have witnessed

some of the rites, whether by accident or carefully planned design. It is not advisable, however, for strangers to go sight-seeing in Penitente territory during Lent. A pain-crazed man in the throes of fanatic ecstasy is not a reasonable human being. There are vague, unconfirmed tales of strangers who never returned from such visits. It is hard for those who have lived among the simple natives of New Mexico for any length of time to believe them capable of molesting anyone.

Sacred to the Indian

The Indian of any tribe is a strong believer in minding his own business. He respects the silence and the personal idiosyncrasies of his neighbor and he rightly expects like consideration. The fact that the ceremonies of the Penitentes seem savage and revolting to the civilized mind, does not alter the fact that these rites are intimate and sacred to them. If common decency will not restrain the morbidly curious, they should be warned that the stolid, stupid-appearing Indian has the "sixth sense" of many wild things and instantly detects curiosity as differentiated from sympathetic interest.

The stranger is welcome in New Mexico and there is much that is beautiful, much that is interesting for him to see. There is an individual charm—not confined to simple external things like scenery or wide open spaces—a feeling, dramatic, strong, big, that comes from the earth. To the outsider such a statement may sound absurd, but possibly this short explanation of the Penitentes may give that outsider an idea of its meaning.

Perhaps someday you who read this may see the snowy tips of the Sangre de Cristo mountains stained red with the startling reflection which is a sunset phenomenon possible only in the rarefied atmosphere peculiar to northern New Mexico. If such be your good fortune, you will understand why the conquistadores called them "mountains of the blood of Christ." If you remember then that clustered against these mountains, high on their plateaus and deep in their recesses, dwell the Penitent Brothers—it may give your appreciation of beauty an added touch of interest and significance.



AN ANCIENT MEETING PLACE OF THE PENITENTES: *adjoining the adobe walls of this century old church at Trampas, New Mexico, is the morada (meeting place) of a cult that has, for generations, practised a barbaric travesty of the Lenten rites*

PENITENTE CRUCIFIXION GROUND: *from the morada the Brothers tread the "Path of Blood" to this hilltop. Here the ritual is climaxed by a symbolic re-enactment of the crucifixion*



★ THE INDOOR EXPLORER

By D. R. BARTON

MUSEUM IN SUITCASES: It is a little disconcerting when you are looking for a staff official of the American Museum's Education Department, under the directorship of Dr. George H. Sherwood, to land smack in the middle of a baggage room.

Surely there had been some mistake. A baggage room is all very well in its place—Grand Central terminal for instance. But somehow one just doesn't belong in the Education Department. And this was a baggage room all right. There were rows of steel racks divided up into shelves that contained suitcases; literally hundreds of them. Maybe it wasn't a mistake after all, but simply a practical joke some overgrown prankster was having on this callow columnist.

Ah well, an apologetic inquiry or two would set us aright. We buttonholed a passerby. This was, of course, not Mr. Herman A. Sievers' office.

Oh, but it was.

Mr. Sievers of the Department of Education?
The same.

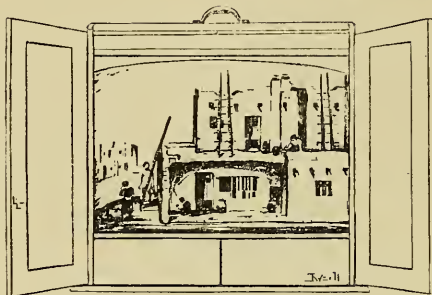
But all these suitcases, surely now—

"These aren't suitcases, they're exhibits."

Our eyes narrowed. This was going too far. "Exhibits, eh," we exploded. "Now look here—" "Very well, if you don't believe me, there's Mr. Sievers, ask him."

Somewhat reluctantly, we accepted Mr. Sievers' invitation to sit down facing a very realistic and very angry-looking bison's head. First of all, we said, we wanted this suitcase business cleared up. Mr. Sievers whisked one at random off its shelf, and slipped open its catches. "Oh they really are exhibits," he said deftly plugging a wire into an electric outlet. When the lid was flipped down his interviewer found himself staring incredulously at a brilliantly lighted Hopi Indian village in miniature, complete with adobe walls, ladders and the braves with their squaws engaged in the daily routine.

It developed that Mr. Sievers had about 3000 such exhibits stowed away in suitcases. "Everything," he said, "that you see in the Museum proper, we have here in miniature."



The "suitcases" are loaned on request to public, parochial and private educational institutions all over the city of New York for periods of one week. "Of course, we have motion pictures and stereopticon slides as well," said Mr. Sievers, "but teachers are generally agreed that these object exhibits are by far the most effective medium. The trucks deliver five days a week—" "Trucks?" "Yes, we have six of them."

It seemed there was an average delivery of 180 to 210 exhibits per day with many requests left unfilled. "See that map over there?" Mr. Sievers' arm swept toward the opposite wall.

"Asia?" we ventured.

"Brooklyn."

The dark ridges we had taken for mountain ranges turned out to be clusters of thumb tacks indicating the location of schools in that borough alone that were "educating by suitcase."

There is an exhibit for every purpose too. Wide-eyed Kindergarteners squabble for places near a "suitcase" showing the developing stages of a butterfly; while, in the halls of higher learning, austere students of com-

parative anatomy take notes on lectures illustrated by the same method. A Neapolitan immigrant makes rapid strides at night school with the aid of the miniature exhibits, and instructors of backward children have obtained striking results through this medium.

Mr. Sievers lighted up another exhibit showing an otter in its natural habitat. "Not long ago," he said, "they brought some blind children in here. I took a lot of animals out of their cases and spread them out on that table. It was fascinating the way they walked around feeling the fur and calling to each other, 'Have you *seen* this one, isn't his fur nice?' Their touch was so sensitive they could almost distinguish colors."

Was the taking of animals out of their cases an exception, only for blind children?

"Not at all. That's one of the advantages of the method. Teachers let them take the specimens out and examine them at will."

Wasn't there considerable loss and damage?

"Not any more. Back in the early days we used to have some trouble that way, but now we get fine cooperation from the teachers."

"How long—" we started.

"—Have we been doing this?" smiled Mr. Sievers, "well that's rather a leading question, but I don't mind telling you that about thirty years ago I was driving a horse and wagon loaded with nature cases. When the horse gave out we switched to an electric truck which habitually came to grief on Brooklyn Bridge. Later on, I made the rounds in a shiny black Ford and was constantly being taken for a physician."

Today the Education Department distributes the Museum in suitcase form to about twenty-seven million scholars, young and old.

The 3000 miniature exhibits facilitate the teaching of biology, all branches of nature study, and astronomy. They make studying geography and history an entertainment rather than a task, and they are of matchless value to students of drawing and design. In almost every field of pedagogy the visual exhibit is replacing the well-thumbed text book and the dreaded birch rod. Educators the world over beat a path (through the "baggage room") to Mr. Sievers' door, the Japanese school system, which is being built up faster than you can say "Manchukuo," having already dispatched two of its emissaries to study Mr. Sievers' methods.

After peering at a bird group that had been retired from active service, we got to wondering about wear and tear on specimens. "Now, there's a funny thing," Mr. Sievers said in response to our query. "We get splendid reciprocity from the schools. The children pick up birds that have fallen during migratory periods, bring them to school and the teachers ship them right off to us to be mounted. Then too, you'd be surprised at the number of sailors who spend their shore leaves up here. And they give us specimens—lots of them."

We were pleased to hear that at least some of the controversial legislation that is current, operates to Mr. Sievers' benefit. We learned that a section of the customs law provides that no animal or bird of foreign origin can pass inspection unless it is directed to a scientific institution. "That means that every time a specimen gift is seized by the customs office the addressees would sooner turn it over to us, than have it destroyed on the spot," our host pointed out. "As to the geography exhibits, like this one," and an illuminated portrayal of tea, from blossom to cup, appeared before our eyes, "commercial firms have been very good about paying the expense of the construction. They write it off as advertising. We get exhibits of almost everything from the manufacture of buttons to the producing of oil that way.

"Advertisers use our exhibits too, you know. Many of these animal series you've been seeing in the newspapers lately were photographed up here."

Commercial photographers and artists, we were told, often set the department buzzing like an apiary. Once an interior decorator, avid for ideas on a Park Avenue bathroom, ransacked the store-room and came up with a seaweed specimen that looked like fine dried pine needles. It was her choice as a prevailing motif.

Another time, a pair of perspiring detective story illustrators pleaded for a shrunken human head, and, after considerable browsing about, made off in triumph with the stuffed head of a small monkey.

Someone recently phoned Mr. Sievers and declared he was calling for Fannie Brice. Mr. Sievers has a turn for humor so he demanded, "Who may that be?"

"Haven't you ever heard of Fannie Brice,

the comedienne?" came in shocked tones from the other end.

"Well to make a long story short," said our host, "Miss Brice wanted to pose for a photograph with a bird. So I told her to come up here and pick one out. That's the one she chose, that little rose-breasted cockatoo over there."

As he was speaking, Mr. Sievers reached into a cabinet, withdrew a fair-sized doll dressed in colorful Italian costume and began to fondle it. His interviewer must have looked somewhat apprehensive, for he hastily explained that his 290 dolls were not for his personal recreation but were also distributed to the schools. "Teachers are exploiting the children's natural liking for dolls in familiarizing them with the costumes worn in different parts of the world," he said. "Now here is a Chinese lady—and this one is an Eskimo hunter—it's all part of the visual education program."

As we were ushered out on our leave-taking, we looked at the baggage room with a new interest and reflected that if education was indeed the keystone of democracy—we had this day met a champion of that institution.



BATS, BUT NO BELFRY: When we were a little boy we got badly bitten by the mystery story germ. The thing we remember best about that period of maladjustment was a feverish thirst after bats. We doted on them. It got so that we chucked a story right out of our sick bed if the author didn't fill up his locale with a lot of bats in chapter one. That explains why so many childhood memories flooded in upon us, when we stumbled on the Philippine Island Bat exhibit while ambling along the third floor of our Museum.

But before we had time even to dry a reminiscent tear, we were struck with an awful truth. We had utterly neglected the beguilers of our infancy. We didn't know anything about bats any more. Of course, we had grown up with some vague notion that bats were creatures invented long ago by a mystery writers' guild, and that the craft of using

them for props had been handed down from mystery writers to their eldest sons from time immemorial. We didn't, you understand, believe this in our heart of hearts; but, tainted by our early affliction, we could have explained bats in no other way had you put us to it.

So we scuttled out of sight before someone asked us, and went in search of more tenable information. After badgering nearly everybody who pretended to a knowledge of them we gleaned that there are about 2,000 different species and sub-species of bats; that the ones who had evoked our tender remembrances, the Philippine Island Fruit Bats, had too remote a habitat to have influenced the authorship of the nineteenth century tales of terror, and, lastly, that the bats that did gain literary fame were helpful little fellows that devoured annoying insects, whereas these winged dwellers of the Philippines were the bane of fruit growers in that region.

The fruit bat, which keeps pretty much to the southern hemisphere, is so called because he eats fruit. Like all bats he is a mammal and sleeps in the daytime upside down. A night feeder, he wakes up at twilight, rights himself, and strikes out in droves sometimes a thousand strong for the plantations. Arriving at a clump of bananas, he carefully selects his evening meal, plucks it, and wings his way back to the tree-top roost. There, he removes the outer skin with a nicety born of long practice, and gormandizes happily at the expense of his unwilling caterers. His menu includes the sweetish, the acidulated and the juicy, thus coinciding with the human taste for fruit.

Since he can gobble up several times his own weight in fruit without recourse to an alkalizer—(and he is lots bigger than his insectivorous cousins)—fruit growers in many localities have to swathe their trees with reams of protective netting. He is a selective gourmand. Don't get the idea that he stuffs a dozen bananas down his narrow oesophagus at one sitting (or in his case, hanging). He simply extracts the essential juicy matter, and doesn't bother to clean up afterwards. That's why they find big patches of fresh pulp underneath the dining trees.

There is one compensation for his voracity. Not over-careful about crumbs, he drops many seeds which serve to propagate wild fruits beyond the confines of the plantations.

He isn't a past master of aviation like his northern relative, his wings being devices to carry him from tree to tree. If unmolested, he will often eat the fruit on the spot.

One reason why mystery writers have passed up this particular species, is his looks. The northern denizen of creepy, old buildings and belfries has a rather blood-chilling face which has always been the fortune and delight of the manufacturers of scary entertainment. Our fruit bat is pleasant and sleek, his head looking rather like that of a small fox, and he insists on trees, not mouldering manor houses, for his home.

Among other things, we learned that bats are the only mammals that can really fly, that they have been flying a couple of million years longer than man has graced the globe, that only a few of them can do better than stumble about on wrists and hind feet when walking, but that, oddly enough, most of them are good swimmers, able to make creditable headway in calm water.

THE COVER THIS MONTH

This design is taken from a larger and finely preserved specimen of the feather cape made by the natives of Hawaii and worn by their kings and nobility in war. The cape illustrated was brought to this country by Captain William Cunningham of Cambridge, Mass., who died in the early part of the 19th century. After being kept in a chest for eighty years it came into the possession of Mrs. L. P. M. Curran of Englewood, N. J., from whom Mr. George S. Bowdoin purchased the cape in 1908 and presented it to the Museum.

Because of the intricacies of manufacture and the difficulties of securing the tremendous amount of feathers required, a century sometimes elapsed before one of these garments was completed.

These feather capes of Hawaii were made on a foundation of carefully prepared netted twine by means of a series of modified square knots, which left meshes of from one-sixteenth to one-quarter of an inch in size. Strips of the netting measuring from eight to eighteen inches in width are pasted together, conforming the cape to the size and shape desired.

The feathers were secured from several species of birds, the natives appointing men whose especial duty it was to snare the birds and obtain the necessary feathers.

The final step in the creation of the cape involved attaching the feathers to the twine net by supplementary threads with a series of half-hitches about the quills which were then bent over and tied again for greater security.

The Master Key to Oil

(Continued from page 373)

genera will be fully covered. To provide maximum ease in using such a compilation, the generic units are to be arranged alphabetically, and within each genus, the species are also arranged in the same manner. Since there are more than 12,000 species and approximately 1100 genera, the completed compilation will consist of twenty-five volumes of 1000 pages each. Here, then, will be gathered the vital portions of the world's literature on this group—a veritable storehouse of information the like of which has never before been seen. And huge as it is, it is linked to a still greater source of materials, the bound photostat copies of every article and paper that has ever been written on Foraminifera. This great library is to be housed in a central clearing-house, and each species and genus in the published compilation will be linked to it through the subsequent references. This phase of the undertaking is, of course, a permanent one, since it will not only constitute a link with past literature, but will also serve to keep the published compilation up to date by adding new materials from current works.

Recruited as it has been from the ranks of the unemployed, the staff carrying on this work is as amazing as the undertaking itself. Artists, typists, paleontologists, geologists, biologists, translators, editors and proofreaders as well as many other professions and crafts are represented. Practically all have at least one university degree, and many have two or more. In age, they range all the way from youngsters just out of college to retired university professors in their seventies. Work can be carried on in more than a score of languages by this group, and for almost every problem that arises, one or more specialists are available to solve it. Small wonder, then, that this organization has won the admiration and respect of every scientist and engineer who has had the opportunity to see it in operation.

What such an enterprise will mean to the petroleum geologist is quite evident. He will still have his problems of buried structure and difficult correlations, but both will have lost most of their former terrors. At last he will be beautifully equipped to read the riddles of hidden treasure and turn them from barriers to sign-posts. Foraminifera are indeed the "Master key," the "X-Ray eyes," so long sought for. Soon, too, the petroleum geologist can marshal a mighty staff of experts to aid him in his work. Hosts of scientists, long since dead, will stand at his side, their wisdom and experience at his command. No longer will he have to flounder hopelessly through mountains of jumbled literature nor be shackled by imperfect, unreliable information. And as the new source books on his desk will link him with these workers of a bygone age, so, also, will the proposed clearing-house for literature and specimens bind him to every living worker in this field. With the savants of micropaleontology as his staff and the world as his laboratory, he can face the future with a much greater measure of assurance and certainty.

Your New Books

Out of Africa—Audubon—Jabo Proverbs—March of Science—Naturalist in Ethiopia

OUT OF AFRICA

by F. G. Carnochan and H. C. Adamson

Dodge Company, \$2.75

OUT OF AFRICA, by F. G. Carnochan and H. C. Adamson, gives, as stated in the authors' Foreword, "a picture of a vanished Africa as seen with a black man's eyes." The black man is Kalola, of the Wanyamwesi Tribe of Tanganyika Territory, who lived from 1856 to 1933. These years were tragic ones from the black man's point of view, for during that time white men took possession of the continent.

Kalola was one of the last great Medicine Men. There are Medicine Men in Africa today, but their influence is only a shadow of that wielded by their predecessors. Their power in the old days was almost unlimited, for no tribal Chief acted without consulting them. Their art was a strange blend of blind superstition, surprisingly accurate scientific information and hard common sense.

The Wanyamwesi Medicine Men belonged to a secret Guild, known as the Empire of the Snakes. Kalola inherited the leadership of this Guild. The first thirty years of his life were consequently full of color and action. His childhood was devoted to preparation for his position in the Guild. As a youth he went as rifleman on an Arab slave safari. With the safari at Ujiji, Kalola saw his first two white men, and heard his first English speech. The speech was Stanley's: "Dr. Livingstone, I presume?"

At twenty-five, as head of the Snake Guild, Kalola became confidential adviser to the great Wanyamwesi Chief, Mirambo. Mirambo has been called the black Genghis Khan. By conquest and absorption of weaker tribes, he came nearer than any other Chief ever did to creating a powerful and integrated black nation in Central Africa.

His years as power behind Mirambo's throne marked the peak of Kalola's career. The latter part of his life was a twilight, during which he witnessed the complete subjugation of his people by the white race. He himself spent these years in hiding from the new authorities, who set out methodically to break the power of the Medicine Men.

F. G. Carnochan, whose ethnological researches have taken him on three African expeditions, became friends with Kalola during the latter's exile. *Out of Africa* is based on information obtained by Mr. Carnochan in their many conversations.

If Kalola's last years were sad and bewildered ones, at least he found time to leave a fascinating record behind him. While the skeleton of the book is the story of his life, about Kalola's figure is hung the rich lore of a whole tribe, with their strange rites and ceremonies, their ancient customs, traditions and beliefs. There are a few spots where the reading is not pleasant; but one could not be squeamish and write with any truth of a people who openly and happily revered sex, whose ideas of justice were simple and direct, and whose gods required constant propitiation, which sometimes took the form of human sacrifice.

Messrs. Carnochan and Adamson have handled their subject with the sincerity and frankness which it deserves. A schedule of dates and an appendix give valuable supplementary information. The whole is a convincing account of "a vanished Africa."

LUCY POPE CULLEN.

AUDUBON

----- by Constance Rourke

Harcourt, Brace & Co., \$3.00

THIS is a very readable volume. Its author has evidently been a diligent and sympathetic student of the abundant autobiographic material bearing on her subject and has thoroughly prepared herself to produce a narrative history of Audubon's life. She seems to have acquired an understanding of Audubon's character and temperament and presents, therefore, a picture of Audubon the man. She writes with apparent authority of Audubon the artist. She appears to be familiar with the America of Audubon's day and writes with ease of the Mississippi valley region in which so much of Audubon's work was accomplished, though we are surprised to find her speak-

ing of modern horses as though they existed in this country prior to the discovery.

We are told of Audubon's childhood in France, of his young manhood at Millgrove near Philadelphia, of his marriage and life as merchant and mill owner in Kentucky, of his travels and explorations in search of material for the still unequalled undertaking he began without a penny in his pocket, of his amazing achievements as artist, author and publisher; but of Audubon the ornithologist we find comparatively little. After all Audubon was an ornithologist and the results of his labors, whether recorded with pen or brush, were designed to be contributions to our knowledge of the habits and appearance of birds. The bird-student asks, therefore, what is the value of these contributions to bird biography? How did Audubon acquire his knowledge of birds? What did he know of birds when in 1820 he definitely committed himself to his life-work? How does Audubon's work as a painter of birds compare with that of his successors?

But we look in vain for replies to these and similar questions. Our biographer repeats without comment Audubon's erroneous belief that the colors of birds' feathers fade soon after death. She writes of Audubon's skill in artistic composition, but says nothing of the degree of success he achieved in presenting the form, pose and personality of his subjects. She includes among the dozen Audubon plates selected for reproduction several which show the artist at his worst. That of the blue-winged teal, for example, was apparently drawn from wired birds in which the wings and feet were improperly posed and the male of the pair placed in the lead.

Evidently, therefore, the ornithologist should collaborate with poet and historian if we are to have a well-rounded life of Audubon.

F. M. C.

SCIENTIFIC PROGRESS

by Sir James Jeans, Sir William Bragg,

E. V. Appleton, Edward Mellanby,

J. B. S. Haldane, and Julian Huxley

The Macmillan Company, \$2.00

IN reviewing the six papers which formed the Sir Halley Stewart Lecture for 1935, it is hardly possible in this brief space to do more than to recommend them immediately and heartily to the reader's attention. Here are outstanding leaders in their various fields—each one attempting to bring within the narrow scope of an hour's lecture the really significant advances in his own science up to the present time—each one attempting to put his finger directly upon the crucial and engrossing problems with which he and his colleagues are dealing. For the general reader interested in a survey of the most important thinking of the day

in these fields, this symposium may be most highly recommended.

In each of these six papers the most interesting and important highlights of the past have been touched upon, those highlights which must become familiar to the reader if he is to understand the evolution and meaning of present-day conceptions.

Sir James Jeans writes of *Man and the Universe*, reviewing the important advances in man's cosmological ideas, from the conceptions of the ancients down through Copernicus, Galileo, Newton and Darwin, ending inevitably with Einstein, de Sitter and Eddington. In the last analysis, Sir James sends us for our true picture of the universe to the mathematician, to whom we must go "if we want the ultimate truth about the universe or its constituents." Sir James' whole paper argues also against the conclusion that our present-day astronomical knowledge need lead us to a purely mechanistic conception of the universe.

The second paper, by Sir William Bragg, treats of *The Progress of Physical Science*, and here we find the latest news about the atom family, chronicling the activities of electron and proton, and leading specifically, as an example, with the protein molecule.

Professor E. V. Appleton, in *Electricity in the Atmosphere*, deals with the unsolved problems of atmospheric electricity, particularly speaking of such things as electricity in the lower and in the higher atmospheres, abnormal radio transmission, and the solar cycle.

The fourth paper, *Progress in Medical Science*, by Dr. Edward Mellanby, gives an "outline of progress made in medicine and medical science through the centuries." In speaking of the present-day aspects of medical progress, Dr. Mellanby, treats, among other things, of the suppression of epidemics, the use of serums, and the great advances in nutritional knowledge.

In Chapter V, *Human Genetics and Human Ideals*, Professor J. B. S. Haldane examines the two interesting theories that "racial health necessitates the sterilization of the unfit," and "that some races are superior to others whose members are incapable of rising to the highest levels possible to humanity."

In the last chapter, on *Science and Its Relation to Social Needs*, Professor Julian Huxley presents a real indictment of our present so-called civilization. Professor Huxley examines the fields in which we have actually been able to apply our scientific knowledge. And then he continues to show the many more important ways in which we are prohibited from applying the knowledge of the scientist because of our economic and social systems, in which the profit motive is the dominant one.

These papers make stimulating reading, leaving one a bit breathless at the long vistas presented, both past and future. They also impress upon the reader inescapably the fact that science may become in the future the true saviour of mankind, although at the present time, because of man's greed and blindness, science has not yet achieved that highest eminence which is its heritage.

MARIAN LOCKWOOD.

ARTIST AND NATURALIST IN ETHIOPIA

- - - - - by Louis Agassiz Fuertes and
Wilfred Hudson Osgood

Doubleday, Doran & Co., Inc., \$5.00

IN September, 1926, Louis Agassiz Fuertes accompanied a Field Museum expedition to Ethiopia as ornithologist and artist. It was his last expedition. In August, 1927, shortly after his return, he was killed by an automobile-railway accident at Unadilla, New York.

As an artist Fuertes has left behind him a record which for all time will mark him as one of the world's greatest painter of birds. As a man he will live in the memory of his countless friends. When they are gone he will be known from the glowing tributes they have paid him, such, for example, as Osgood places at the end of this volume.

In the printed word Fuertes left almost nothing. His brush and field studies claimed all his time. How thankful, therefore, we should be for the publication of this day to day field journal in which Fuertes, unconsciously, gives us an outline sketch of himself. To help round out the story Osgood adds his journal and we thus have a dual account of each day's events.

After securing an outfit of 30 men and 50-odd mules and horses at Addis Ababa, the expedition divided into two sections of which Osgood,¹ the leader, and Fuertes formed one, while Bailey, Baum and Cutting made the other. Each followed different routes in pursuance of their somewhat unlike purposes. Together, they covered nearly 2000 miles in the saddle, made over 200 camps and, with the aid of native helpers, collected nearly 2000 birds and an equal number of mammals.

Baum has already published his story of the section to which he was attached, and the present volume completes the narrative of *Savage Abyssinia* (Sears), what was evidently a well planned, successful undertaking.

Although his duties as a collector of birds and the demands of camp-life must have made constant demands on Fuertes' time and strength he nevertheless secured one hundred paintings of birds. As a whole they are far and away superior to anything he had before made in the field. He seems to have been inspired by fresh, keen reactions to totally new experiences.

The entire lot were presented to the Field Museum by Suydam Cutting, who subsequently defrayed the expense of adequately reproducing 32 of them for inclusion in a portfolio issued by the museum. The 16 plates here included were selected from that portfolio. Only a few of them are finished drawings, and from these we name the frontispiece of a kingfisher and head of a tawny eagle (facing p. 98) as representative of Fuertes' ability to depict not alone a bird's portrait, but its personality as an individual.

The inclusion of photographs would have in-

¹ See an article on Ethiopia by Dr. Osgood in *NATURAL HISTORY* for April, 1935.

creased the value of the text not written for publication in its present form, and the addition of an index would have made more readily accessible the large amount of information the volume contains.

F. M. C.

MORE SONGS OF WILD BIRDS

- - - - - by Albert R. Brand

Thomas Nelson & Sons, \$2.50

THE title of this volume might well read "More and Better Songs of Wild Birds," so greatly have Mr. Brand's records of birds' songs improved over those presented with his earlier work in 1934. The text, also, shows the well-considered results of added research and the work as a whole expresses the notable progress that Mr. Brand and his associates at Cornell have achieved in a field that they have made their own. Moreover, Mr. Sutton's line-cuts of the *dramatis personae*, in some mysterious way, seem to add a note of realism to the records.

It is these records that give the book its distinctive character. Wholly aside from their value as tangible contributions to the physics of bird song, I think of them as reaching three classes of listeners:

First. Those who will use them as aids in identifying the originals and who will unquestionably find them helpful in this capacity.

Second. Those who are familiar with the originals and will find most of these reproductions marvelous but some of them libelous.

Third. Those who have not, and probably never will, hear the originals and who, in spite of Mr. Brand's warning, will accept these records as adequate presentations of them.

When, for example, I recall, vividly, my impression of the Pine-wood Sparrow's song as first I heard it, 50 years ago, I hate to think that others will gain *their* first impression of it from what, in the light of an imperishable memory, is to me an inadequate record.

I fear, therefore, that I am *not* among those who, to quote Dr. Allen's "foreword," "do not mind the march of progress into the woods and fields," nor can I, to quote again, "accept strawberry jam in December" as a satisfactory substitute for strawberries in June.

F. M. C.

GONE SUNWARDS

- - - - - by Cecil Roberts

Macmillan, \$2.50

IF you aren't going to Florida this winter, get a copy of Cecil Roberts' *Gone Sunwards*, settle comfortably in front of the fireplace and be as-

sured of as fine a picture of that much ballyhooed winter paradise as words can give.

By the time you are half way through the book, you should, if there is any suggestibility in your makeup, be ready to pack your grip and board the next train or boat bound for the land of sunshine, booms, and orange groves. If you do so, take the book along with you. It contains a wealth of fascinating lore about Florida's background and history with much of which even the most inveterate Floridan is unacquainted.

Author Roberts is a Britisher and he came from faraway London to winter on the Gulf Stream. He knows his way around Florida and his visit is set down in smooth-flowing language well sprinkled with the anecdote and shrewd comment of a man who is an expert traveler as well as an accomplished writer.

If there is a fault in the book, it lies in the fact that Mr. Roberts has "written up" Florida a trifle too glowingly in spots. He affects a certain slavishness before the extravagant resort life that is rather surprising in one of his proud and allegedly phlegmatic race, and he indulges occasionally in that suavely ingratiating humor, of the Oscar Wilde-Michael Arlen-Noel Coward school, which this reviewer finds personally unpleasing. Too high praise cannot be given, however, for the author's treatment of the landscape and wild life of the state. His description of the Everglades is most compelling, and his eye for the beauties of Nature throughout Florida is alert and unerring.

JABO PROVERBS FROM LIBERIA: INTERNATIONAL INSTITUTE OF AFRICAN LANGUAGES AND CULTURES

- - - - by George Herzog (with the assistance of Charles G. Blooah)

Oxford Press, \$2.50

TO the Jabo tribe of Eastern Nigeria the proverb or parable is a vital mechanism. The integration of life can be summed up in a proverb. The new is incorporated in the formalized generalities of the old. A multitude of segregated themes in the native's life are simplified and made comprehensible by the encompassing proverb. "When it rains the roof always drips the same way (15)," shrugs the Jabo man in explanation of the immutability of certain laws.

The proverb has a real function in native law. Trials are an exhibition of the lawyer's skill in remembering and applying proverbs. Even the linguistic form of the proverb is adapted to oratorical and poetic effect.

Dr. Herzog has made an admirable selection of proverbs, parables, and maxims. He presents them in classified order according to the subject matter involved, and the range is wide. The proverb is printed in the phonetic equivalents of the Jabo

tongue with a word for word interlinear translation. This is followed by a free translation. In most cases additional information is necessary to explain the allusions, interpret the amazing imagery, and to give examples of actual situations in which the proverb is used. Some of the sayings are readily understandable without much further comment, such as: "The tree grows up before we tie a cow to it (31)," which implies that experience is demanded before much trust is placed in a man. On the other hand; "If a Man is not seasoned, he will split (306)," takes on significance with Dr. Herzog's explanation that rice, before being pounded, must be thoroughly dried to avoid its splitting and becoming awkward to handle.

As Dr. Herzog points out, many of the proverbs are prefaced by the designation of the speaker: "Crab says: if you see your fellows in the mud, you join them (55)." Since one species of land-crabs gather in great numbers in muddy spots, it is appropriate that the crab should speak. Or, in another example; "Chicken says: if you scratch too hard, you come upon the bones of your mother (107)." While this refers to the fact that chickens scratching in the village trash-heap may find their mother's bones, it is used to quell gossip.

The book is delightfully written. Mr. Blooah, who assisted Dr. Herzog, is himself a Jabo with education at the University of Chicago. His explanations and comments are indicated in the book and they have not been greatly changed from their original flowery style.

The rather formalized presentation of the material in no way detracts from its intrinsic charm and readability. In fact any less formal arrangement would seem forced. The student of folk-lore is given comparative references both in the text and in an appendix at the back. The sociologist and psychologist will find the classification of proverbs a positive aid. The general reader will find amusement and fascination in this intimate picture of the Jabo thought patterns and customs. "A man's ways are good in his own eyes (212)."

W. C. BENNETT.

THE STORY OF HUMAN ERROR

- - - - - Edited by Joseph Jastrow

D. Appleton-Century Company, Inc., \$3.50

HARLAN T. STETSON, C. Judson Herrick, Harry Elmer Barnes, and many other leading scientists have contributed to this novel symposium on the "false leads" in the development of science. Professor Jastrow has ably edited the book and also written sections of it himself. The story is divided into two parts: part one, *The World*, deals with the cosmic, physical and living realms, and part two, *Man*, concerns the human realm of science and its application in sociology, medicine and psychiatry. Each essay takes the form of a synopsis of the history of the author's particular field of science with stress laid upon the errors revealed in that history.

Many of the mistakes of science have been errors of observation and description, but by far the greatest number are errors of interpretation and causal relationship. In the earlier history of science faulty interpretations were frequently the result of the argument by analogy, which may be illustrated by the fact that walnuts were once prescribed for brain trouble because the hard shell remotely resembles the skull and the softer, convoluted kernel resembles the brain. The errors of modern science are largely what Professor Parshley in his essay on zoölogy calls *tentative*, that is, "errors inherent in the scientific method of trial and error, which are consciously regarded as on trial before they are unmasked and discarded." In his essay on the science of physics, Dr. Swann has clarified for us the outstanding contrast in the old and new approaches to specific problems. "The hypotheses and dogmas of modern physics differ from those of the ancients not so much in the matter of artificiality as in the fact that modern hypotheses are *chosen* with Nature as a guide.

They are chosen so as to fit Nature, whereas the

hypotheses of the ancients were chosen ofttimes from principles having no immediate connection with Nature or with the branch of it under discussion, and this choice was then followed by an attempt to force Nature into them." Dr. Swann's statement summarizes in essentials the views of his co-authors, and forms a basis for the understanding of the scientific error so prevalent among the early philosophers.

The Story of Human Error merits a careful study by those interested in the future of science as well as its past history. These sixteen scientists have laid bare the mistakes of their ancient colleagues and several of their contemporaries as they trace the gropings of humanity toward a more perfect understanding of its environment. The book as a record of events up to the present day is well organized and quite complete. As we of today judge the science of the past, so, perhaps, shall we in turn be judged in the light of a higher knowledge of the future, for the chronicle of human error is as endless as humanity itself.

G. MILES CONRAD.

Science in the Field and in the Laboratory

Fossil findings — Astronomy Exhibits and Lectures — Bird News—British-Columbia Expedition

Fossils

Doctor Barnum Brown, Curator of Fossil Reptiles in the American Museum of Natural History, recently returned from the west, where he visited several National Parks and made important discoveries.

Doctor Brown, accompanied by Mr. R. T. Bird, of the laboratory staff left New York August 22nd by motor car to make a special examination and report on the great Dinosaur National Monument near Vernal, Utah, for the National Parks Service, with which the American Museum of Natural History is cooperating in developing this important educational park.

"The Dinosaur National Monument," said Doctor Brown, "is located near the main highway between Salt Lake City and Denver, in northeastern Utah, where the highway U. S. 40 crosses Green River. At this point surrounding Split Mountain, the sedimentary rocks are tipped up at an angle of 80 degrees, brilliantly colored, and are composed of Mesozoic sediments that accumulated during 50,000,000 years.

"One stratum of Jurassic sandstone that was deposited approximately 140 million years ago carries untold numbers of dinosaur remains; in fact,

complete and partial skeletons of practically the entire dinosaur fauna of the Jurassic period now known from the southwestern United States.

"This rich dinosaur graveyard was first worked by the Carnegie Museum, which took out 7 carloads of fossils during a period of 14 years, after which the area was declared a national monument by the United States Government during the Wilson administration.

"Since 1931, Doctor Brown has been instrumental in directing the development of the Dinosaur National Monument and during the past few years, various groups of emergency workers have been making a great cut necessary to expose more of these skeletons buried in the rock. During the past year, the project was taken over by the National Parks Service, which is to continue the development and complete the cut—190 feet long, 40 feet wide and 30 feet deep—removing many thousands of cubic yards of stone and clay.

"After the cut has been made American Museum representatives with air-chisels, will "sculpture" out in relief, the skeletons embedded in the sandstone, thus exposing the remains which originally had been lying horizontal before the mountain's uplift. The relieving is a slow and careful process

and can be done only by experienced technical workers. After this work is completed, the government will construct a building of which this large fossil slab will form the entire northern wall. When the building is completed it is planned to place on the opposite vertical wall an enormous mural painting, showing the animals in their natural habitat millions of years ago, and in the center of the building accurate models of animals whose bones lie embedded in the opposite wall.

"The government will develop a water system, houses for maintenance, parking grounds and facilities for unlimited numbers of automobile visitors. The State of Utah will construct the road leading from the main highway to the monument, which is planned to be one of the greatest in educational value of all the National Parks."

After completing his survey at the Monument, Dr. Brown went on to the Painted Desert near Cameron, Arizona, where he was joined by Mr. G. D. Guadagni of Boston. There, in the lower Triassic strata, on the Little Colorado River, the party discovered and unearthed the skull, jaws, several vertebrae and humerus of a large alligator-like creature that is new to science. The size of these bones indicates a reptile 30 feet in length, which would stand about 4 or 5 feet in height. This reptile is quite evidently new, as the teeth are like those of a phytosaur, and the 4-foot skull is extremely broad, with a rounded snout, whereas the skulls of phytosaurs are narrow and pointed.

It was near this spot that Doctor Brown excavated many hitherto unknown dinosaur tracks in the lower Triassic, and Permian rocks. In the Little Colorado River Valley Doctor Brown had previously discovered 42 standing tree trunks in one group in 1901 and these stumps were relocated.

In the region of the Petrified Forest many interesting rare Triassic plants were secured for exhibitions in the Dinosaur Hall.

On the return trip to the east, the party stopped at the farm of William Thompson, near Argos, Indiana. There, they excavated the bones of a mastodon, lying so close to the surface that plows had broken the skull. The tusks, limb bones, foot bones, most of the ribs and several vertebrae and the pelvis were recovered. Doctor Brown believes this mastodon died about 10,000 years ago, and the position of the animal showed it must have bogged in the quicksand which still underlies the cornfield of today. In the moist, peaty material surrounding the remains were Pleistocene shells and many of the plants, seeds and pieces of wood of that time. Cones from trees similar to present-day junipers and pine indicate that those trees were plentiful in that region during the Pleistocene period. Today, the pines and junipers have almost disappeared from this part of Indiana.

Mr. Guadagni drove from Boston to the Big Bend of the Rio Grande, Texas, where he excavated for the Museum one of the largest and best preserved Cretaceous palm leaves known, which is to be exhibited in the Hall of Cretaceous Dinosaurs.

Next month Doctor Brown is expected to publish an article and a series of photographs in *NATURAL HISTORY* illustrating this trip.

On the second floor of the Planetarium, in an exhibition case near the North Entrance to the Planetarium dome, is an interesting exhibit of specimens collected by Dr. Clyde Fisher on his recent expedition to the meteor craters in Estonia. These specimens include burnt dolomite rock and powder from the craters, as well as shells of gastropoda found at the time of excavation beneath the layers of dolomite.

An interesting exhibit of seven pencil drawings of the moon is on view on the bulletin board, first floor of the Planetarium. These drawings are the work of Mr. Arthur-Louis Sands, of Newton, Massachusetts.

The Christmas Stars is the subject of the Planetarium lecture for the month of December. The heavens will be shown as they appeared two thousand years ago at the time of the birth of Christ, with the Star of Bethlehem shining in the sky. Various theories will be presented concerning the real identity of this famous object which has been the subject of so much debate and research.

On December 3rd the third in the current series of special lectures will be given by Miss Dorothy A. Bennett, Assistant Curator, on the subject *Wandering Worlds*. On December 17th, Miss Marian Lockwood, Assistant Curator, will present the fourth lecture in the series, on *The Glorious Aurora*. These lectures are on Thursday evenings from six to seven o'clock. Since they form part of a series, no single tickets will be sold. The subscription fee for the six lectures is \$2.50.

A celestial navigation course consisting of twenty-four two-hour lessons in the principles and practice of both aerial and marine navigation is offered. Four of the periods will be held in the Planetarium dome. The other twenty will consist of lectures, actual observations, computations and use of instruments. All lectures will be conducted by outstanding authorities. The tuition for the entire course is fifty dollars. Although some of the meetings have already been held, those who are interested may apply for further information to the Planetarium office.

The meetings of the Amateur Astronomers Association are now held in the Auditorium of the Roosevelt Memorial Building, entrance on Central Park West at 79th Street. On December 2nd, Professor C. A. Corcoran, Chairman of the Physics Department of the College of the City of New York, will speak on *Gravitation and Relativity*. On December 16th, Mr. Leo Mattersdorf, Third Vice-President of the A. A. A., will speak on *Eclipses*. These meetings begin at 8:15 promptly and are open to the public. Various interesting classes, both elementary and advanced, are also carried on by the society. Information concerning these can be obtained by communicating with The Secretary, A. A. A., Roosevelt Memorial Building, American Museum of Natural History.

During December the following radio talks will be given over Station WHN under the auspices of the Amateur Astronomers Association. The time is Friday, 6:30 to 6:45 P. M. Watch your daily newspaper for possible change of date.

- December 4—*The Christmas Star*—by Mr. William H. Barton, Jr.
 December 11—*Terrestrial Magnetism and Solar Activity*—by Mr. Joseph L. Richey.
 December 18—*The Winter Solstice*—by Mrs. Virginia Geiger.
 December 25—*The Winter Sky*—by Mr. Charles A. Federer, Jr.

The meetings of the Junior Astronomy Club are now held in the Roosevelt Memorial Auditorium, entrance on Central Park West at 79th Street. On December 5th, Mr. Hubert Bernhard will speak on *The Human Side of the Stars*, and outdoor observations will be carried on. On December 19th there will be a competition on the subject of the Two-Hundred-Inch Telescope. These meetings are open to the public and are held on Saturday afternoons at three o'clock. Information concerning the activities of the group may be obtained by communicating with *The Junior Astronomy Club*, The Roosevelt Memorial, American Museum of Natural History.

The monthly journal, *The Junior Astronomy News*, is published by the Club from December to May, and includes the advance Astronomical Calendar as well as popular material on the science.

Ornithology News

Dr. James P. Chapin is continuing his studies of the birds of central Africa at the Musée du Congo Belge in Tervueren where every facility for prosecuting his work has been given him.

With the opening of the Roosevelt Memorial the Collection of Birds found within 50 miles of New York City has been moved to the ambulatory on the first floor (driveway entrance) of that building. Here better light and increased space permit of its more effective display as well as of additions to the section containing the Birds of the Month. The individual, accessory groups showing the nests and eggs of local birds, which were formerly placed with the local collection near the lunch-room, have been temporarily moved to the alcoves in the Hall of Flying Birds.

The Annual Meeting of the National Association of Audubon Societies was held in the lecture hall of the Roosevelt Memorial October 26-27th. The program included reports from the leaders in the many fields in which the Association is now active and also papers by authorities on diverse types of conservation. The whole was well designed to impress one with the progress shown by modern methods of conserving wild-life and its haunts.

Mr. Kermit Roosevelt was reelected President of the Association and Mr. John H. Baker its Executive Director.

The Department received an interesting collection of about 170 birdskins from Tanna, New Hebrides, one of the few islands of the South Seas not visited by the South Sea Expedition. The particular interest of this island is, that it was discovered by Cook on one of his memorable voyages through the South Seas, and some birds were collected by his naturalist, Forster, which were described by Latham and Gmelin. Mr. L. Macmillan not only

succeeded in getting some of these typical Tanna birds, but he also added several species to the Tanna list, two of which were unknown to science.

Dr. Mayr is now actively engaged in the working out of the birds of the Vernay Hopwood Expedition to the upper Chindwin River (see this magazine, vol. 36, p. 37). He finds that the birds of this district form an interesting transition fauna between a western element, coming from Assam, northeastern India, and an eastern element, coming from northern Indo-China and southernmost Yunnan. On the other hand, there is very little relationship with the birds of further south (Siam and Tanasserin).

The collections of the Bird Department continue to be of service not only to the members of the Museum staff but also to workers in other institutions. During the last few weeks the Department has been visited by a number of ornithologists and friends who have examined material in the Museum collections and have also inspected the new quarters of the Department in the Whitney Wing. Among the callers have been Dr. Jean Delacour of Châteaux de Clères, France; Mr. C. M. B. Cadwalader and Mr. James Bond of the Academy of Natural Sciences, Philadelphia; Mr. A. L. Bailey of Colorado State Museum, Denver, Mr. I. M. Gabrielson, Chief of the Biological Survey, Washington, D. C., Mr. J. J. Darling, former Chief of the Biological Survey, Mr. Alexander Sprunt of Charleston, S. C.; Dr. Casey Wood, of Chicago; Mr. Randolph Jenks of Morristown, New Jersey and Arizona; Mr. J. C. Greenway of the Museum of Comparative Zoölogy, Cambridge, Mass.

Recently, also, specimens have been sent on loan to Dr. Claude B. Ticehurst and Mr. N. B. Kinnear of the British Museum, London, Dr. Herbert Friedmann of the United States National Museum, Washington, D. C., Dr. H. C. Oberholser of the U. S. Biological Survey, Washington, D. C., and Mr. James L. Peters of the Museum of Comparative Zoölogy, Cambridge, Mass.

William F. Coultas is in the field on the Crocker Pacific Expedition securing material for certain groups of birds to be installed in the Whitney Memorial Hall. He writes from Samoa that he has been quite successful in obtaining material from that group of islands.

On alternate Tuesday evenings beginning on October 13th, Dr. Robert Cushman Murphy has been conducting a well attended course for members of the Museum. His general subject is entitled *The World of Birds* and the course is this season's contribution to the "Know Your Museum Series" which has been increasingly popular since it was first organized by the Museum's Department of Education.

The subjects of the lectures thus far given are *The Bird's Place in Nature*, *Methods of Bird Study*, and *The Geography of Birds*. Each talk has been followed by an informal conference and by visits to various exhibition halls and to the laboratories and study collections of the Department of Birds. Aspects of bird study thus far considered include the following: fossil birds; the affinities, evolution and adaptive radiation of birds; living birds in the experimental laboratory; modern bird watching in

the field; environmental tolerances and their significance; birds as indicators of life zones on land and sea.

The concluding lecture of the series on November 24th, on *The Behavior of Birds*, dealt with learned and unlearned responses in birds, the extent of their intelligence as compared with that of other animals, and the significance of territory, courtship, migration and other patterns of activity which throw light upon the mind of animals in general.

Rumsey-British Columbia Expedition

The acquisition of a fine series of big game and small mammals from northern British Columbia was made possible through the splendid cooperation of Mr. E. Roland Harriman and the generous support of Mr. Bronson H. Rumsey. The members of the expedition included Messrs. John P. Meade and John W. Pitney, who proved of valuable assistance in the capture and preservation of specimens, and Mr. Dawson A. Feathers, American Museum representative and official collector. After two months in the field, the expedition returned early in October, bringing back six Stone sheep, five mountain goat, three caribou, and one grizzly bear. It is interesting to note that one of the sheep taken by Mr. Pitney is the second largest Stone sheep on record, the horns measuring 45 inches in length, with a base of 16½ inches, and spread 25 inches. In addition to the big game animals, are 150 specimens including beaver, otter, lemmings, and other small mammals, such as shrews and rodents.

Characteristic of the difficulties that overtake those who tarry too long in the mountains of the Northwest, the Rumsey-British Columbia Expedition was caught at Deadman's Lake in a blizzard of unprecedented magnitude for the season. Between five and seven feet of snow fell in a continuous storm that lasted four days and four nights, and it was only through the fine heroic work of everyone concerned that they were able to get out without losing a number of horses, and bring out their trophies.

Amateur Telescope Making

The Hayden Planetarium and The American Museum of Natural History, in cooperation with New York University, Division of General Education, offers a course in

Amateur Telescope Making

By Ramiro Quesada

Beginning Thursday, December 3, 1936

At 7 P. M.

At the Hayden Planetarium Optical Workshop,
81st Street and Central Park West.

This course consists of a series of twenty-four lessons of three hours each, during which time the student will have the opportunity, not only to learn the technique of telescope making, but will be expected to complete a telescope mirror which will become his own property at the end of the course. This will provide him with the major item for his observatory. Special mechanical ability or pre-

vious knowledge is not required. The fee for the course, including necessary supplies, will be \$35.00. Facilities for registration will be provided at the first session, but inasmuch as registration is necessarily limited by the workshop facilities, the student is urged to send his application, with fee to

PROFESSOR H. H. SHELDON
Division of General Education
New York University
20 Washington Square North
New York, N. Y.

This course is an outgrowth of one conducted by Mr. Quesada for the Amateur Astronomers Association for many years in the past. Many amateurs have made exceptionally good mirrors with the aid of Mr. Quesada's instruction and experience. This presents a real opportunity for the person who knows nothing about telescope mirror making to start from the very beginning and end with a very useful glass.

The class will meet each Thursday night from 7:00 to 10:00 P. M., unless the registration is sufficient to require a second group meeting each Tuesday night for the same time. If further information is required, address Professor Sheldon, as above. Anyone interested is invited to attend the first session of the course on December 3rd.

Student Science Clubs Christmas Program

The annual Christmas science program of The American Institute Student Science Clubs will be held as usual at the American Museum on December 28 and 29. Participation in this program is open to all of the Institute's member science clubs in New York City and suburbs.

The Christmas Lectures will be held at noon on each of these days, with two world-famous scientists or explorers speaking on each program. This year Dr. Harlow Shapley of the Harvard College Observatory will speak. And either Dr. Hugo Eckener or Captain Lehman of the new German dirigible "Hindenberg" will also appear. The other two speakers will be announced at a later date. These lectures will be broadcast over a national hook-up so that all science clubs and all young people interested in science over the country may have the opportunity of hearing them.

The Christmas Lectures are modeled somewhat on the Christmas series held by the Royal Institution of London for over a century. The British series have been conducted by such brilliant scientists as Faraday, Tyndall, Bragg and others. It is the plan of The American Institute to provide an opportunity for the young people of America also to hear the world's great scientists. In the past two years such men have appeared on the Institute program as: Dr. Harold C. Urey, Nobel Prize Winner in Chemistry, Dr. W. F. G. Swann, Director of the Bartol Research Foundation of Swarthmore, Captain A. W. Stevens, Commander of the 1935 Stratosphere Flight—the highest ever made, and others.

The Science Congress for clubs will also be held on these two days. The Congress is based in plan on meetings of the American Association for the Advancement of Science, with section meetings on

a variety of science subjects held simultaneously. At these meetings members of the clubs read papers or give demonstration talks of their researches in the clubs during the school year. A junior club member acts as the chairman of each meeting and leads the discussion which is invited after each paper is read. Prominent scientists are asked to attend the meetings as an honor to the speakers, but they take no part in the program which is conducted entirely by the boys and girls themselves.

In the past papers of great merit have been presented. And meetings on many specialized subjects have been arranged, including such general topics as: Genetics, Microscopy, Cinphotomicrography, Photomicrography, Electrified Gases, Light Waves, Aerodynamics, Airplane Construction,

Chemistry of Visible Particles, Applied Chemistry, Combustion, Biology, Biological Preparations, etc.

Fresh-Water Fishes

Mr. Michael Lerner, Field Associate of the Department of Fishes, and Mrs. Lerner sailed on November 14th to spend several months in Africa. While there, Mr. Lerner plans to collect fresh-water fishes for the Museum's collection.

Charles Hayden

At a meeting of the Board of Trustees Charles Hayden, the donor of the Planetarium instruments and in whose honor the Planetarium is named, was last month elected a Trustee of the American Museum of Natural History.

RECENTLY ELECTED MEMBERS

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

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Mrs. George B. deLong.
Mr. Frazier Jelke.
Mrs. Marion Brown Shelton.

Life Members

Messrs. Nicholas Cox, David Adam Turner.

Sustaining Members

Messrs. James Fleming, Charles W. Giles, George S. Turner.

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Misses E. C. Boetticher, Jane A. Catlin, Martha D. Havens, Cornelia Roovers, Lillian Willard.

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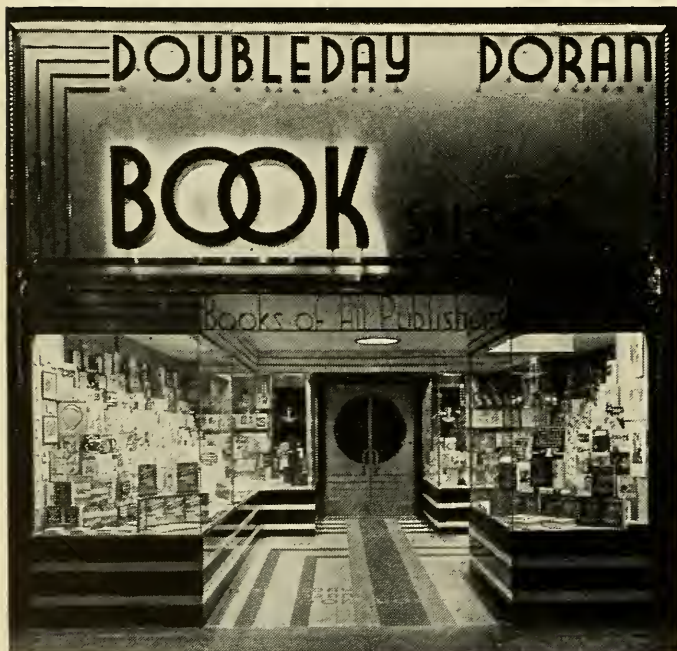
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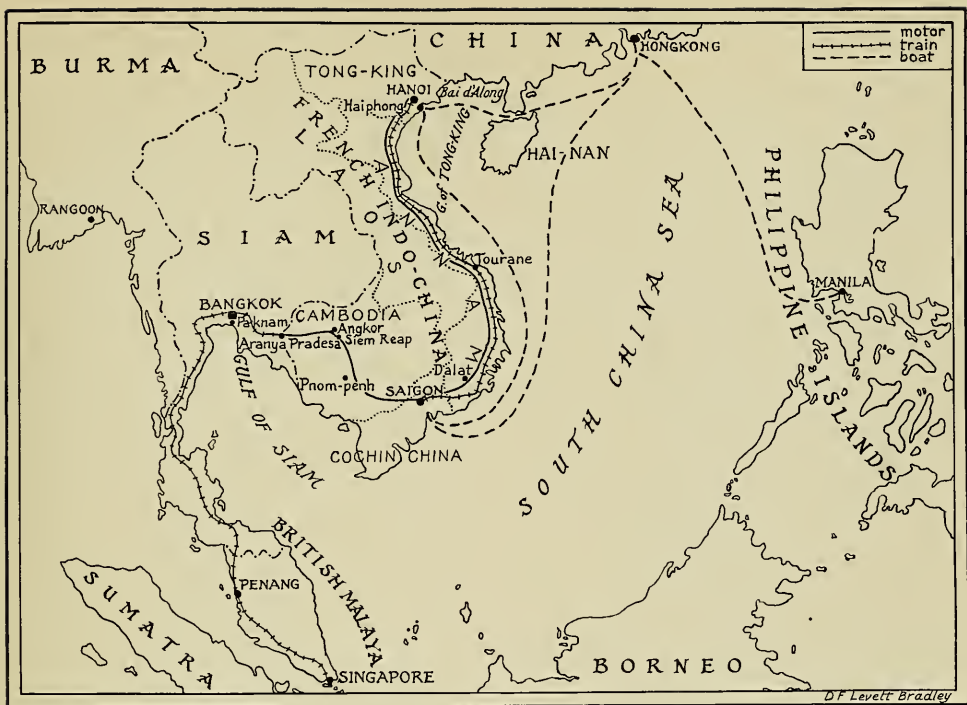
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PASSPORT TO *INDO-CHINA*

THE photographs of Indo-China, contributed to this issue of *NATURAL HISTORY* by Dr. James L. Clark, Director of the Department of Arts, Preparation and Installation, will give you some idea of the unusual interest of a country that is seldom visited in the ordinary course of travel and yet can quite easily be included in a trip to the Orient or a round-the-world cruise. Although the principal steamship routes from the United States do not touch at the ports of Indo-China, by adding a few extra days this fascinating country can be included in your itinerary. The two main points of departure for a detour to Indo-China are Hongkong (westbound), or Penang on the Malay Peninsula (eastbound). From Hongkong it is only 2½ days by steamer to Saigon and from Penang, two days by train and motor to Angkor via Siam.

BIG GAME COUNTRY: Besides the remarkable ruins at Angkor to recommend it as a place of interest to *NATURAL HISTORY* readers, Indo-China provides an opportunity for the most timid traveler to see for himself the big game country pictured in the pages of this magazine. Here, the life of the jungle begins at the very doorstep of civilization. Doctor Clark, in telling of his recent expedition, says, "Along the main motor highway from Saigon to Hanoi could be seen tiger tracks and evidence of elephants in the vicinity. The latter frequently uproot the railroad signposts and trample the palm

trees alongside the road." There was always the danger that an elephant might inadvertently walk into camp at night and yet, every morning fresh rolls were delivered by train from Saigon for breakfast.

HANOI: The length of time can be devoted to a visit to Indo-China will determine not only what to see, but the route. If your time is limited you can transfer to a boat at Hongkong that will take you direct to Saigon. From Saigon, it is a short two-day motor trip to Angkor, where at least two days should be allowed for visiting the ruins. From Angkor to Penang, where one can pick up one of the larger ships again, takes approximately three days. Although hurried, the entire trip can be made in little over a week. If three weeks or more can be added to your itinerary for the trip to Indo-China, you can take a coast-wise ship at Hongkong for Haiphong, the port for Hanoi, instead of sailing direct to Saigon. The journey from Hanoi, in the Northern province of Tong-King, to Saigon in the South, takes in some of the most beautiful scenery and points of interest, including the locale of Doctor Clark's expedition, in Indo-China. Hanoi, itself, is well worth a visit. An ancient capital, it has been modernized by the French who have occupied it since 1900. A day's sightseeing in Hanoi can include a walk or rickshaw ride around the Petit Lac, a lake in the heart of the city with a charming

temple built on its Isle of Jade; the Botanical Gardens and the Mot-Cot, or Pagoda of the Single Pillar.

From Hanoi it is about a one hundred-mile motor drive to Hongay on the Bay of Along, one of the most beautiful bays in the world. At Hongay you can hire a launch to take you out for a day's excursion on the Bay, visiting some of the fascinating islands that once supplied a haven for pirate fleets. One should be sure that a tender is included for landing at the islands, also a flashlight for exploring the caves. Although the round trip can be made in a day from Hanoi, there is a hotel at Hongay for those who wish to stay longer.

The trip from Hanoi to Saigon can be made in two days by train and cars may be hired for sight-seeing at the various stopping places. If one can afford the additional time and cost, to go by motor, which requires approximately a week, is more interesting and pleasant. Both modes of travel follow the coast through Hue, Tourane and Dalat. In the country around Tourane lived the Chams, who were among the chief enemies of the Khmers of Angkor and who helped to destroy the ancient Khmer civilization. Scattered through the jungle are the remains of the temples and other buildings of the Chams. Some of these may be seen from the main motor road. A stop should be made in Tourane to visit the Museum which contains the most famous collection of Cham sculptures in existence. From Tourane, also, a short excursion can be made to the Marble Mountains where centuries ago pious Buddhists built sanctuaries in the cliff caves. This trip can be made by motor or launch and takes only half an hour each way.

SAIGON: From Tourane to Saigon you pass through the low-lying coastal country of Annam with its tropical jungle where wild life and civilization meet—a modern motor road with tiger tracks, with the sound of elephants in the nearby bush at night and a glimpse of wild peacocks in their native habitat. When you arrive at Saigon, you will find a miniature Paris transported into the jungle. As there is a large European population and continental atmosphere many days could be pleasantly spent in Saigon but if your time is limited to sight-seeing, a tour of inspection can be made by motor or rickshaw, including the suburb of Cho L'On.

PHNOM-PENH: There is no railroad from Saigon to Angkor; one goes by motor. Scheduled motor buses make the trip regularly but are not as comfortable. The cost of a private motor from Saigon to Angkor is approximately \$60.00, and the trip requires two days with a stop over-night at Phnom-Penh. By leaving fairly early in the morning you can arrive at Phnom-Penh, the capital city of the King of Cambodia, in the afternoon in time to do all your sightseeing the same day. The chief place of interest is the Royal Palace with its crown jewels, ornate halls and stables of sacred white elephants. Not far from the Palace is the Museum which contains an unrivaled collection of Khmer and pre-Khmer art. On the way from Phnom-Penh to Angkor you will pass the ruins of many ancient Khmer buildings.

ANGKOR: The highlight of any trip to Indo-China is a visit to the remarkable ruins of the ancient Khmer civilization at Angkor. Dr. Harry L. Shapiro, Associate Curator of Physical Anthropology of the American Museum, says of Angkor, "The most frequently figured of all Khmer monuments in Cambodia are the ruins of Angkor. The Angkor-Wat is a work of art, a masterpiece of architecture, and the tourist may spend days without ennui wandering about seeing ever new aspects of startling beauty; the student may spend years of absorption trying to encompass all that were worthy of study."

A millennium ago Cambodia was the scene of one of the proudest kingdoms in the Orient. Today, although the French have cleared the jungle and skillfully restored in part the gravest ravages, the process of disintegration is everywhere evident in the spectacle of massive stone buildings enwrapped in the roots of giant trees. The sources of information concerning the life, the history and origins of the Khmers have been principally the Sanscrit inscriptions found on the walls of buildings, the bas reliefs which decorate the galleries of the temples and factual accounts written by early Chinese travelers. One of these, writing in the Thirteenth Century, described the glory of Angkor at its proudest, the royal processions, the towers of gold and ivory, the rich temples assigned to the worship of the Brahmanic and Buddhist pantheons, and the hordes of slaves captured in war that characterized this reign of luxury. It is at present established that Khmer architecture has a history which goes back at least to the Fifth or Sixth Century and terminates in the Thirteenth. For centuries after the disintegration of the Khmer empire the magnificent buildings at Angkor were swallowed by the jungle. The first intimation that came to the west of the existence of this lost city was in 1601, but the modern interest in Cambodia may really be dated from their rediscovery by Mouhot in 1861.

The ruins of Angkor consist of the Temple or Wat, and of the city itself, Angkor-Thom. If you have only two days to spend at Angkor, one can be devoted to seeing the Angkor-Wat and Angkor-Thom and the other to taking the two regular sight-seeing trips. However, it is advisable to spend a longer time if possible. The climate makes walking in the middle of the day extremely arduous. As in most tropical countries, foreign residents as well as the native population remain indoors from noon to about four o'clock. If you wish to be within walking distance—elephants are provided for those who prefer this romantic approach—of the ruins you can stay at Dak Bungalow in Angkor. There is a new hotel with more modern equipment at Siem Reap, twenty minutes from Angkor. On leaving Angkor you can either return to Saigon or motor the short distance to Aranya Pradesa, on the border of Siam, and from there take the train to Bangkok and Penang.

TRANSPORTATION: The possible combinations of steamship travel that can be arranged to include a visit to French Indo-China are too numerous to give a complete list in this article. However, the

principal sea routes from the United States to Indo-China are as follows:

STEAMSHIP VIA THE ORIENT: To go to Indo-China by way of the Orient one may take any one of a number of first-class lines as far as Hongkong, China, or Manila and change at either of these points to a smaller line going to one of the ports of Indo-China. Or one may take one of the larger steamers as far as Singapore or Penang and from there take a train up to Bangkok, which is only a few hours from Angkor.

The Dollar Line round-the-world ships leave New York every two weeks for the Orient via the Panama Canal, including among their stops, Havana, San Francisco, Honolulu, Kobe, Shanghai and Hongkong. This trip takes about fifty days but can be shortened by embarking at San Francisco. Other lines sailing from the West Coast and touching at Hongkong and Penang are the N. Y. K. (Japanese) Line from California and the Canadian Pacific, which runs on a regular fortnightly schedule from Vancouver.

From Hongkong ships of the Messageries Maritime and Cie. Indochinois sail regularly to Haiphong or Saigon in Indo-China. The coast-wise ships, though small, are comparatively comfortable and make the trip from Hongkong to Haiphong, the port for Hanoi, in three days; or the larger vessels of the Messageries Maritime direct to Saigon in two days. On leaving Indo-China you need not return the same way but can pick up a Dollar Line or other first-class ship again at Penang and continue around the world or return to the United States by way of China and Japan.

STEAMSHIP VIA EUROPE: The best passenger line going directly to Indo-Chinese ports is the Messageries Maritime, which maintains a regular fortnightly service from Marseilles to Saigon. Arrangements can be made through the French Line (Compagnie Generale Transatlantique) for passage from New York to Saigon via France. The trip from Marseilles to Saigon, stopping at many interesting ports, takes approximately three weeks.

The trip, via Europe, may also be arranged through the Cunard Line, transferring in England to the Nippon Yusen Kaisha Line which goes to Penang and Singapore, where you can take a train to Bangkok, Siam and thence by rail and motor to Angkor.

CRUISE SHIPS: The Cunard White Star Liner, Franconia, sailing from New York January 7th on

a cruise around the world, provides an optional tour to Siam and Indo-China. From Penang, on the Malay Peninsula, the trip is made by special train via Bangkok to Angkor where two days are allowed for sightseeing.

The Empress of Britain world cruise, leaving New York January 9th, includes an optional tour to Bangkok and Angkor. Cruise passengers taking this trip leave the ship at Penang on March 1st and rejoin it at Paknam on March 6th.

BY AIRPLANE FROM CALIFORNIA: By the time this is printed it is expected that the Pan-American Airways will have included the final stage of its route, from Manila to Hongkong, in its schedule. A Pan-American Clipper Ship leaves San Francisco every Wednesday, taking five days to Manila with over-night stops at Honolulu, Midway, Wake and Guam Islands. From Manila to Hongkong on the Clipper will take an additional six or seven hours. The cost of the trip from San Francisco to Hongkong will be approximately \$900.00.

CLIMATE AND CLOTHES: As more than a thousand miles separates the northern and southern extremes of Indo-China, the climate varies. Saigon and Angkor, near the equator, have tropical heat the year round and only the thinnest clothes are required, while Hanoi, in the north is cold enough at certain seasons to require a warm coat. November, December and January are the best months to visit Indo-China. February and March can be included. April and May are the most uncomfortable.

WHAT TO BUY: Perhaps nowhere in the world will you find silver displaying such fine workmanship, and at so low a price as in Indo-China. The Museum at Angkor is the local agent for the native craftsmen and is the best place in which to buy silverware, although it is also sold in the shops in Saigon. Other native products which are well worth bringing home are carved camphor chests, carved stone antiquities and pottery.

There is scarcely a quarter of the globe that offers greater rewards to the traveler interested in native life, archaeology and natural history than Siam and Indo-China. Mention cannot be made here of the many curious animals that are native to this region, but one may even have opportunity to witness the Archer Fish in action, whose habit of shooting insects for food with a drop of water propelled from its mouth was described in the June *NATURAL HISTORY*.



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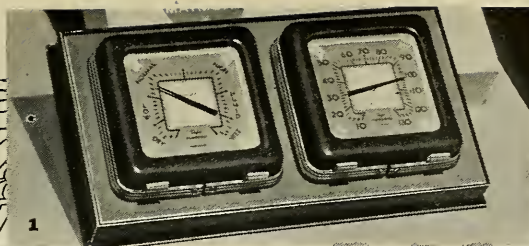
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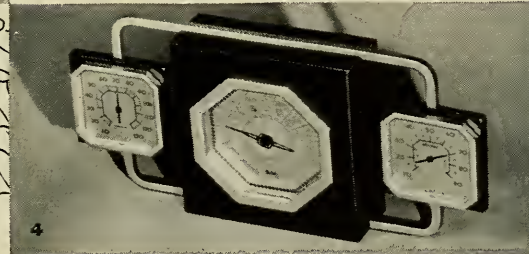
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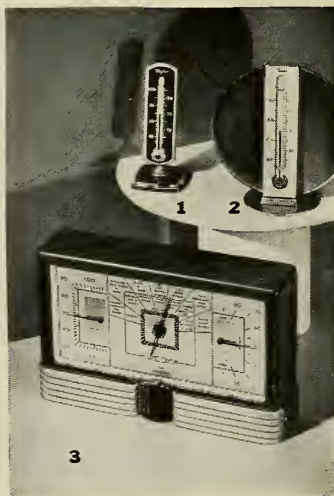
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